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SIR EDWARD LEE AND THE ALEXANDRA PALACE.

IT has become in our day of intense activity and labour a question of no ordinary importance, what shall be the amusements of the people? Recreation of some kind is more necessary now than ever, and it may be taken as evidence of an improving public taste that the days of roistering fairs, with their senseless rollickings are over, and that there is an increasing demand for pleasures more intellectual and æsthetical.

The Alexandra Palace has been erected to supply to the citizens of the metropolis, and especially to the residents of the Northern districts of London, an inexhaustible round of rational amusements. Like its Sydenham prototype it will be sure to attract countless throngs of holiday-makers, and considering its advantages of scenery and its peculiar attractions it cannot hold a place inferior to that favo[illegible]e resort of the people. The first Alexandra Palace erected on [illegible]well Hill was destroyed by fire on the 9th of June, 1873. All London sympathized with the company, and regretted the disaster which came so cruelly upon the proprietors, after such a successful and brilliant opening. It was at first feared that the enterprise was dead, but with the greatest zeal and public spirit the company resolved to erect a better building on the same site. The natural beauty of the place, the charming scenery, and unusual advantages for out-door amusements, seem to mark the spot as an unrivalled site for a pleasure palace for the people. It may be that the serious lesson taught by the conflagration was of great value, for the new building appears much more secure from fire than its ill-fated predecessor. The new edifice is really a series of detached buildings constructed with substantial brick walls, and fire could hardly extend from one to another. The palace covers $7\frac{1}{2}$ acres and is 400 ft. long by 200 ft. wide. While the former building was a long and narrow nave intersected by three transepts, this describes a parallelogram and covers a much larger area. The architectural effect is good, and although one might imagine a more beautiful design it would be difficult to devise a more useful one for the objects intended. The building looks very substantial and even handsome. At each principal corner a square tower rises to the height of 100 ft., surmounted by a pyramidal mansard roof rising 80 ft. higher. In the top of these four towers are reservoirs of water containing each 16,000 gallons. There are also four other reservoirs in the building containing each 7,000 gallons. All these are replenished from the reservoirs of the New River Company by engines pumping 11,000 gallons per hour, and prove that full precautions have been taken to guard against another fire. At either end of the structure are glass domes. The façades of the building have been constructed of white Huntingdon and dark yellow bricks, the ornaments and mouldings being of Portland cement.

The brick-work gives a solid look to the edifice, and one much

more substantial than the light iron and glass construction, which may be cheaper at the outset, but continually requires expensive repairs. There is something permanent in a building that requires 16¾ millions of bricks to build it, 19,838 bushels of Portland cement, 3,010 tons of lime, 11,964 bushels of common cement, 1,392½ tons of cast iron, 780 tons of wrought iron, 57 tons of putty, and in its roofs, windows, and doors, 5¼ acres of glass.

The grand central hall will no doubt be found one of the finest in England for large musical assemblages and social gatherings. Its roof, the central portion of which is semi-circular, is supported on four rows of columns, and covers a space 386 ft. long by 184 ft. wide. It is lighted by two broad belts of white glass, with ruby borders, set in the arched roof, and running the length of the room, and by the rose windows of the gables at each end. The circular windows of coloured glass, and also a series of lunettes, which form a clerestory, add much to the cheerfulness of the hall. It is expected that 12,000 people can be seated here. The floor is level, and it may be that some who are compelled to take a back seat will find it difficult to see over the heads of those in front, while the pillars will obstruct the view in some places, but for a grand ball or for a promenade nothing could be better than this magnificent hall. Its acoustic properties are pronounced perfect. At one end is the orchestra, which will seat 2,000 persons, and here is placed the gigantic grand organ, the work of the celebrated Mr. Henry Willis, the builder of the mammoth organ of the Royal Albert Hall, and other well-known instruments. This organ has five claviers, including the pedal, and 104 stops and accessories. Two steam engines of seven or eight horse power will be brought into requisition to supply the air for the bellows. The decorations of this great hall are novel but pleasing. The paintings are in the Cinque-Cento Italian style, and statues of all the kings and queens of England, from William the Conqueror to Queen Victoria, are arranged along the hall at the bases of the columns, and are designed to illustrate the regal costume of each historical period. On the walls are placed the coats of arms of English cities and counties. Much the largest portion of the hall is beneath the arched roof, which has a span of 85 ft. A row of gas jets encircling the room at the summit of the gilded capitals which support the arch, will give a brilliant illumination at night. The Hornsey Gas Company have erected works and appliances for lighting the Palace, and have made large provision for balloon ascents.

The theatre, which will seat more than 3,000 persons, is situated in the north-east corner of the building. The stage is capacious, and fitted up with all the latest improvements in stage machinery. It has a depth of 50 ft., and an extreme width of 84 ft. Every necessary mechanical appliance for the effective representation of dramas, pantomimes, and operas has been provided, and every spectator will have an uninterrupted view of the stage, for the seats rise gradually from front to rear. Two galleries, one above the other, are at the back of the theatre, opposite the stage.

The concert room occupies a corresponding position on the north-west side. It is large and cheerful, it seems well adapted to musical purposes, and will hold 3,500 persons. An organ has been constructed for this room by Mr. H. Willis.

There is a noble conservatory at the western entrance, under one of the glass domes. It is filled with rare plants and flowering shrubs, and in the centre is placed a large garden fountain.

Beneath the corresponding dome at the east entrance, the space is reserved for articles on exhibition, but not for sale. Between this and the grand hall in the centre transept, and extending 213 ft. by 140 ft., is a space set apart for the exhibition of articles intended for sale. Here are placed a great number of ornamental stalls, which will be occupied by the best dealers in the trades represented.

Special arrangements will be made for the exhibition of carriages and piano-fortes, and there will also be room for the display of artistic models of buildings, and engineering constructions.

In the rectangular space flanking the west side of the Grand Hall is a large open Italian garden, laid out with walks, and the only portion of the interior not roofed over.

A great feature of the Alexandra Palace will be its picture galleries. In addition to many valuable works lent to the company, an arrangement has been concluded with the President of the Munich Art Association for an annual exhibition of paintings to be sent from the continent. The annual season-tickets of the company are issued on the basis of an art union, by which 20 per cent. of the gross amount realized by their sale will be devoted to the purchase of works of art which have been exhibited in the Palace, and which will be distributed as prizes among the season-ticket holders.

The amount to be expended annually in prizes will be £210 10s. for every 1,000 season-tickets sold; that is to say, there will be a work of art given as a prize really worth £100, one worth £20, one worth ten guineas, two prizes valued at five guineas, two at £3 10s., four at £2 10s., and forty at one guinea each, also ten season-tickets for the following year. If the sale of season-tickets reaches 10,000, the prizes will represent a sum of £2000; and so on in the same proportion. This system will ensure the success of the department of fine arts; and no doubt many of the finest works produced in this country will find their way to the galleries of the Alexandra Palace.

The Londesborough collection of arms, armour, and antiquities has a room set apart for its reception in the western extremity of the building. It is the finest collection of arms and armour in existence, and will display many objects of interest to the archæologist as well as to the general public.

The "Whitfield Collection" of natural history specimens will be exhibited in another large room near the western entrance.

The billiard-rooms and the reading-rooms, supplied with all the leading journals, daily, weekly, and monthly, will be accessible to all season-ticket holders, and will be an attractive feature.

All the arrangements for heating the Palace were planned and executed by Mr. Wilson W. Phipson, C. E., of London, and have been in successful operation four months already. The complete apparatus is very extensive. There is an aggregate heating surface of 55,400 feet from 12 miles of hot-water pipes, laid in brick channels, and covered with continuous cast-iron gratings. There are three multitubular boilers, each 16 ft. long, and 6 ft. in diameter, fixed in the central basement of the building, which supply steam for the heaters placed in hot-water channels, and are employed in warming the Central Hall, the Picture Galleries, and the Commercial Exhibition Department. Four Cornish boilers, each 20 ft. long, and 5 ft. in diameter, are placed in the basement of the Angle Towers, and are used for heating, in the ordinary way, the Concert Hall and the East and West Conservatories.

The building was designed by the Company's architect, Mr. John Johnson, of 14, Buckingham Street, Strand, and the contractors are Messrs. Kelk and Lucas. The interior decorations were executed by Mr. Schmidt, from the designs of the architect.

The directors have given the refreshment contractors, Messrs. Bertram and Roberts, every facility. There are magnificent dining halls in the Palace itself, as well as smaller rooms for dining in private; and there is a vast banqueting-hall in the Park, which will accommodate 1,500 persons. This hall, as well as smaller rooms, will be available for annual festivals or bean-feasts. The southern front of the Palace is devoted to this department.

The splendid suites of private dining-rooms, which are reached by two broad staircases, as well as the public rooms below, have been beautifully furnished. On this upper floor there is an immense dining hall 200 ft. by 55 ft. where 1,000 people can comfortably dine together. It is hardly necessary to add that the arrangements of Messrs. Bertram and Roberts are most complete, that their kitchens are fitted up with every modern improvement, so that every kind of repast, from the most luxurious dinner to the simplest refreshment, can be had without delay, of the best quality and at a reasonable price.

The London Stereoscopic Company has acquired the exclusive right of photographing within the Palace and grounds, and suitable studios have been provided.

The Palace Company has its own orchestral and military bands, consisting of skilled performers, and a trained choir of more than three hundred vocalists, who have been in practice for more than two years. This efficient musical staff will be able to render perfectly the oratorios of Handel, Haydn, and others, as well as the classical works of other great masters.

Muswell Hill on which the Palace stands is encircled by a chain of hills, and the intervening valleys display all the beauties peculiar to an English landscape. Hamlets, churches with ivy-grown towers and with pointed steeples, fields of the deepest emerald, enclosed by hedgerows, railway lines stretching miles away in dim perspective, lakes of clear water and thickly wooded groves, make up the lovely panorama.

The Alexandra Park is more than 220 acres in extent, and has been carefully laid out by Mr. M'Kenzie, the consulting landscape gardener of the Company. Private carriages can drive through the Park to the doors of the Palace, and the roads have been planned with this special end in view.

The race course at the foot of the southern slope is a distinctive feature. It is over a mile in length, and a beautiful and substantial Grand Stand of stone has been erected near it. There is also an American trotting ring in this portion of the park, which can be used for bicycle races or athletic sports.

The cricket ground is ten acres in extent, two acres larger than Lord's, and there are two pavilions with every convenience for

THE ALEXANDRA PALACE.

cricketers. Important matches will take place here during the summer.

In one of the artificial lakes at the north of the palace a water village has been constructed on piles, which gives a picturesque look to the landscape. On this lake, 5 acres in extent, there will be fine opportunities for aquatic sports and boating.

A circus to accommodate 3,000 spectators has been erected near the upper lake, where Mr. Hengler will conduct the performances during the summer.

Our account of the Alexandra Palace would not be complete without some allusion to the Grove which borders the western entrance of the park. This beautiful spot, where overshadowing oaks, and tall firs and cedars make the most grateful shade in summer, will be thrown open to the public three days in the week, and the company's military band will add the delights of music to these sylvan attractions.

The Japanese village, transferred from the Vienna Exhibition, and the Moorish and Egyptian houses within the building, near the eastern entrance, will be worthy of a visit from those who are interested in the study of ethnology.

There will be direct railway communication to the Palace from King's Cross by the Great Northern Railway, and Wood Green station is at the foot of the hill opposite the eastern entrance.

An enterprise of this nature depends very much upon the efficiency of its management, and in this respect the Alexandra Palace Company has been singularly fortunate. Sir Edward Lee, the manager of the Company, is the son of the Rev. F. G. Lee, M.A., vicar of Stantonbury, and grandson of the late Rev. T. T. Lee, B.A., for nearly fifty years vicar of St. Mary's, Thame, Oxfordshire. Here Sir Edward was born in 1833. He was educated at the Grammar School of his native town, and manifested in early life a taste for the fine arts. By subsequent study he acquired an extensive knowledge of various branches of art and art manufacture. When holding an official position in the literary department of the Crystal Palace at Sydenham he successfully organized, in connection with that company, a school of art, which has since grown into one of the most prosperous educational institutions in this country. In the year 1862 he was engaged as manager of the Exhibition Palace at Dublin. The organization of that establishment was entrusted entirely to his care, and in connection with it Sir Edward Lee instituted a loan museum of art treasures, including a National Portrait Gallery of Irish Worthies, which was perhaps one of the finest collections of historical portraits ever brought together. At the close of the Exhibition, in recognition of his important services, he received the honour of knighthood.

After the satisfactory conclusion of his labours in Dublin, Sir Edward Lee was solicited to undertake the management of the new Alexandra Palace, which it had been determined to erect on the site of the original one, unfortunately destroyed by fire.

Sir Edward's elder and only brother, the Rev. Dr. F. G. Lee, is the representative of the ancient family of Lee, of Pocklington, Yorkshire, a member of which, Sir Henry Lee, will be remembered as one of the most interesting characters in Sir Walter Scott's "Woodstock." The Rev. Dr. Lee has deservedly won the reputation of being one of the most eloquent preachers of the present day, as well as one of the most accomplished and learned contributors to theological literature.

Sir Edward's labours in behalf of the Alexandra Palace have been arduous, and it may be hoped that the people will appreciate all his efforts to provide a great variety of sensible and elevating amusements.

CHEAP Galvanic Battery.—This battery consists of a cylindrical glass vessel, 8 in. deep, and about the same in diameter. On the bottom of this vessel a circular sheet iron plate is placed, with an insulated wire extending from the plate over the top of the jar. This plate is covered to the depth of one or two inches with sulphate of copper. Another iron plate is suspended above the sulphate of copper, and soft water is poured in until the upper plate is covered to the depth of one or two inches. Thus made up, and the circuit completed, the battery will come up to its power in two or three days; but if needed to work at once an eighth of an ounce of sulphuric acid should be added. The plates must be arranged horizontally one above the other. If the upper plate is a quarter of an inch thick it will last a year. These iron plates are said to work just as well as zinc and copper, and are much cheaper.

WAYS TO SUCCESS.

OVER fifty years ago, a youth, working on a farm, asked his father to give him money enough to buy a gun. The old man could not spare it, but the boy, nothing daunted, found an old piece of iron about the place, and in the course of time contrived to make a gun barrel out of it, with the very meagre facilities afforded by a country blacksmith's shop. He had not the materials to make a lock and stock, so he walked to the nearest town and traded for the necessary attachments, and was encouraged by the smith for having made so good a shooter: this gave him the ambition to make another, so he went to cutting out grindstones from the native rock to raise the money for gun materials; in a short time there was a considerable demand for guns of his make. During the French war with Prussia, he was called upon to furnish guns for the army, and in less than eight months he made and delivered to the government of France rifles of a particular pattern, costing five millions of dollars, which amount was duly paid. The same man furnishes rifles now for the United States, South America, Rome, Spain, Egypt and Japan. The farmer's boy who wanted a gun is Eliphalet Remington, of Ilion, N.Y. His manufactory covers four acres of ground, and he employs twelve hundred men. Not satisfied with this achievement, he has recently completed a sewing machine, which is reported to represent the latest and most perfect advance in the improvements of this important adjunct of domestic economy. This is the type of a boy who, when there is not a way, makes a way for himself.

Many a youth would have sat down and pouted, thinking over what a hard thing it was that he could not get a gun, with hard thoughts against the father for being so stingy. Not so with young Remington; he wanted a gun and was determined to have it; the very necessities of his situation stimulated him to the exercise and consequent development of his powers of planning and devising; in other words, of thinking for himself. And such are they, the world over, who achieve noted success. Those who think for themselves plan for themselves, and upon themselves lean. So it was with Fitch, and Goodyear, and Howe. Their early history was the history of a struggle with privation, and want, and litigation, and almost despair; and the immortal Morse must be added to the list, owing all to their patience, and courage, and indomitable persistence. If young Remington had been supplied with a gun he would have "gone a-gunning," and fallen gradually into a kind of idle, loafing, aimless life, a burden to himself and a benefit to nobody. The very necessity of effort has been the making of many; while many more, who have had their wants gratified for the asking, have sunk into insignificance, and their name and memory have long since perished from the earth.

Some have been heard to express a wonder that the human family should be permitted by Infinite Benevolence to struggle against poverty and want. But as the human mind is constituted, it is better to struggle than to idle, better to work than to wait; better to lean on one's self than on another. It is the men who, as boys, struggled for a foothold in the world, who now wield the world's destinies, and do the most to mould its history.

AGRICULTURAL MACHINES.

THE business of the agricultural engineer is, if viewed in one aspect, one of the oldest industries in the working of metals that can be found; even in the Old Testament, where the blessings of peace are prophesied to the Jews, we read, "They shall beat their swords into ploughshares and their spears into pruning-hooks." Viewed in another and more scientific way, it is one of the most modern applications of science to be found in industrial history. Like some other industries it owes its latter aspect to the advent of the steam engine; but, unfortunately, for some period after men of ability had turned their attention to what they deemed the higher and more dignified branches of steam engineering, agriculture, and

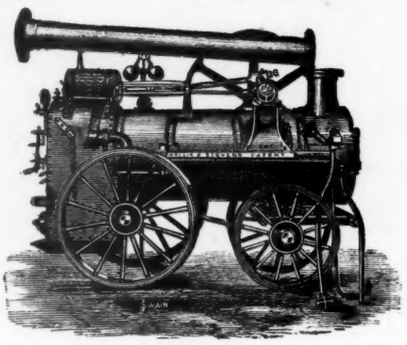


Fig. 4.

the mechanical appliances requisite for its proper development, were left in the background, and for a time such steam and other machinery as was produced did little credit, either to the makers thereof, or to the country at large. The engines were ill proportioned, badly fitted, and inferior materials were used in their construction. The farmers, too, had a contempt both for innovations and for those who advocated them; consequently the engineer had but little inducement to work for so inappreciative a set of clients. The tide of progress floats every man's boat, however, whether he will or no, and if individuals cannot escape, it is not likely that classes and businesses will do so, and the agricultural business of the country in its turn felt the influence of science, and while it must be admitted on the one

Fig. 5.

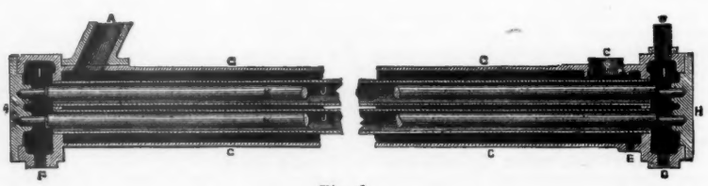


Fig. 6.

hand that the scope for agricultural engineering, in the real and now accepted sense of the term, was at no distant date contracted and uninviting, on the other hand, even the little there was to reward was not turned to account, or sought after by good or able men, and for some time after the achievements of other engineers had become the world's wonder, little was done in agricultural machinery or the application of steam to it as a motive power. The last decade has seen a great change in this respect, and any person competent to judge who will go to any of our agricultural shows, either at Islington or elsewhere, will be forced to admit that while agricultural engineers have still much to learn, they have done much to redeem their reputation. Portable engines, as now made by the leading firms, are really creditable specimens of steam engineering, are well proportioned, well fitted, and the materials used are generally fairly good. Machinery for aiding the production, preparation, and working of bread-stuffs ought to take that elevated rank in engineering that of right belongs to appliances for the direct supply of the first of all human necessities, bread, and if manufacturers will but steer clear of too much conservatism in their labours, there is little doubt that such will be the case at a not distant date.

We hope from time to time to illustrate and describe the agricultural and bread-stuff machinery made by different eminent makers, both of this and of other countries, and we trust because we now select some of the machinery of one or two firms for our present impression, that other equally eminent firms will

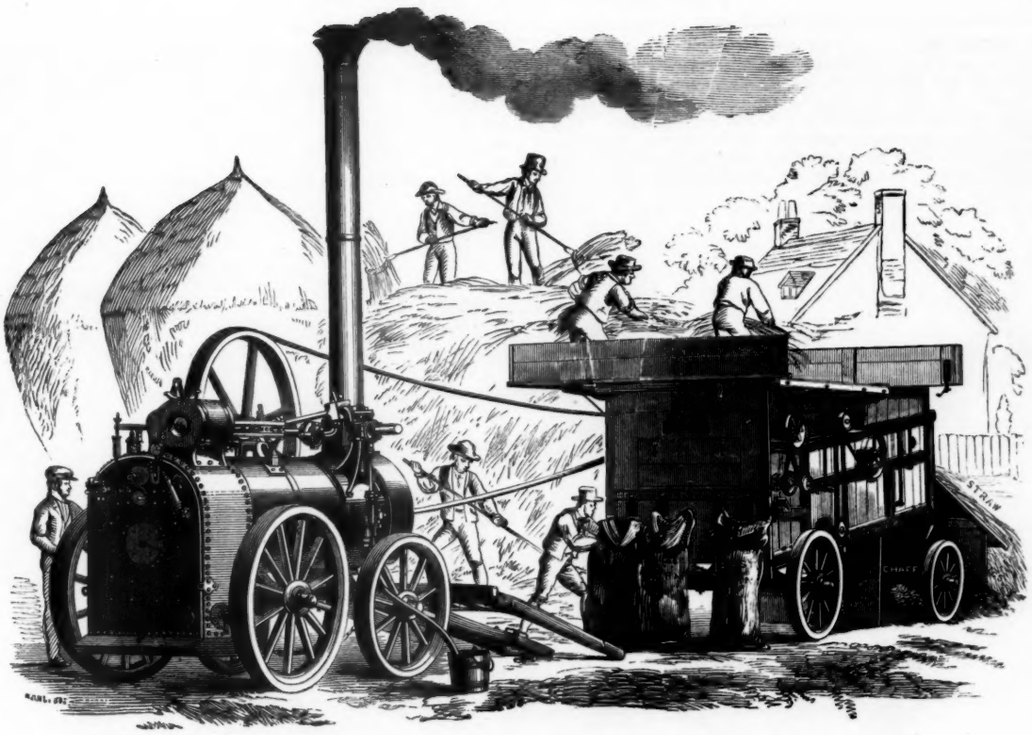


Fig. 1.

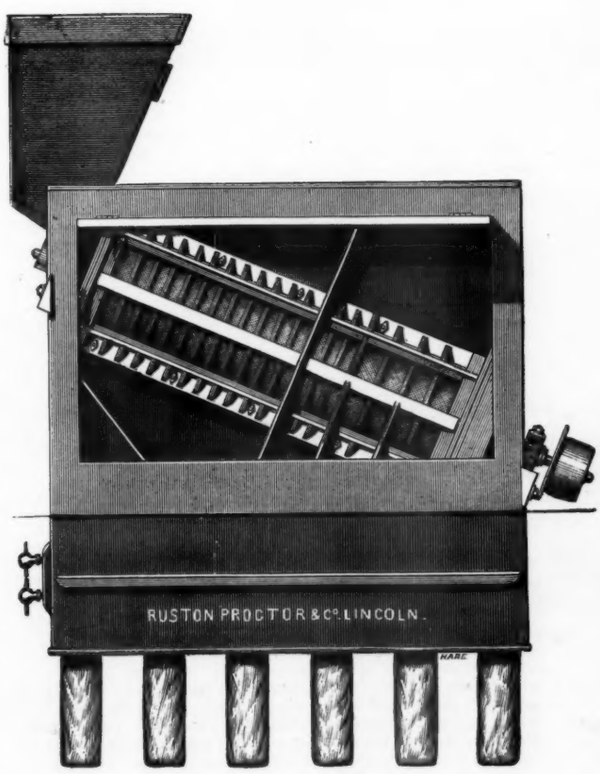


Fig. 2.

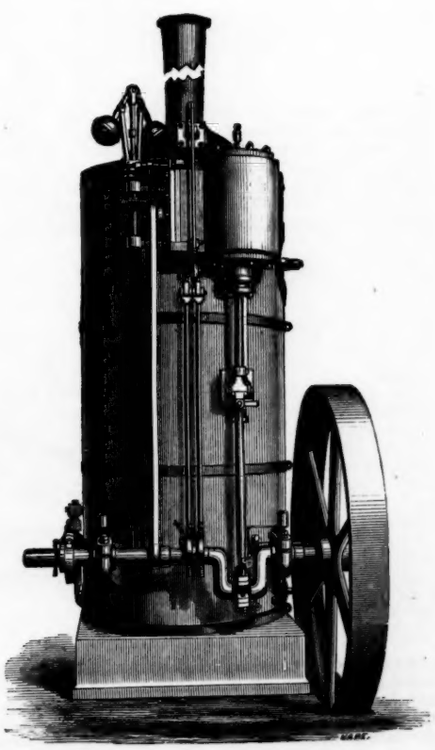


Fig. 3.

not consider that we show an undue preference; obviously we could not in a single article notice even all the specialities of one firm, much less those of all at once. In our present number we illustrate and describe some of the machines respectively of Messrs. Ruston and Procter and Wallis and Steevens. Fig. 1 illustrates the general arrangement of the former firm's portable engine and threshing machine while at work. As may be seen, the corn in the ear is thrown into the drum above, and a sheaf loosened and fed in, is in a few seconds dissected into straw three qualities of grain, chaff, seeds, and the broken stuff known as "cavings." Hereafter, perhaps, we may be able to give our readers a section of the complex machine which performs these marvels, and also details of the construction of the engine. Fig. 2 illustrates a flour-dressing machine, made by the same firm. As will be seen, it is an axle and screen enclosed in a casing; the axle is set on an incline and is armed with a series of brushes;

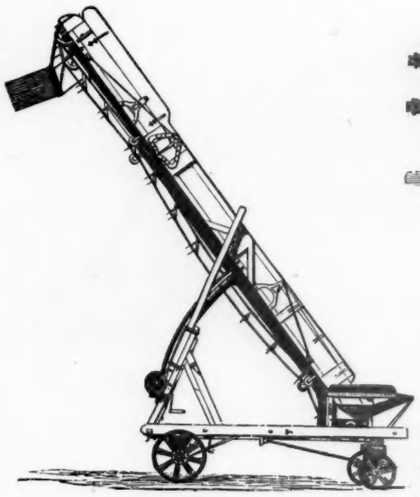


Fig. 10.

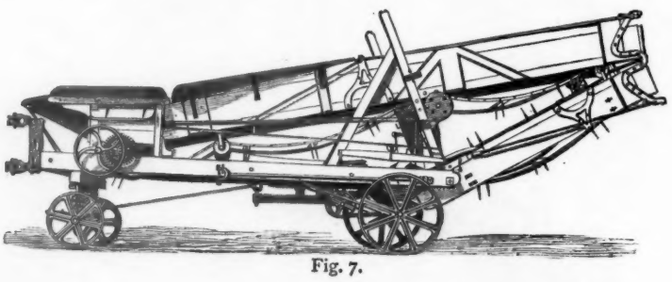


Fig. 7.

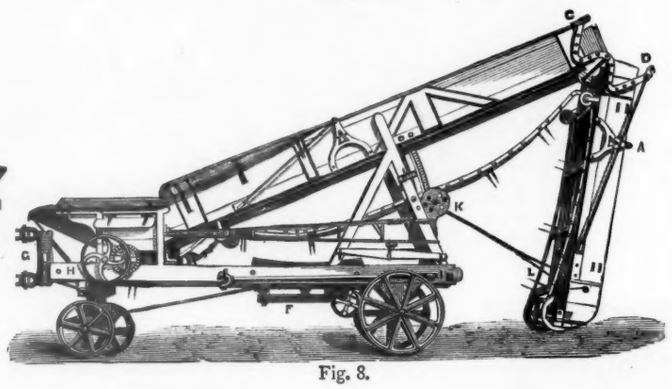


Fig. 8.

the screen casing is in three divisions—fine, finer, finest,—and the flour being put into the hopper at the higher end, the axle and brushes are rapidly rotated, consequently the flour is worked down and brushed through the screens which divide it into three qualities. Fig. 3 is a very neat vertical engine made by Messrs. Ashby and Jeffrey. The arrangement of the parts is so simple as not to need much description. This form of steam engine is becoming very popular of late years, and vertical engines in one form or another are now made by many of the leading agricultural firms.

Fig. 4 illustrates a portable engine made by Messrs. Wallis and Steevens, and fitted with their patent feed water-heater, illustrated in detail at figs. 5 and 6, which shows respectively the cross and longitudinal sections of the contrivance. It consists

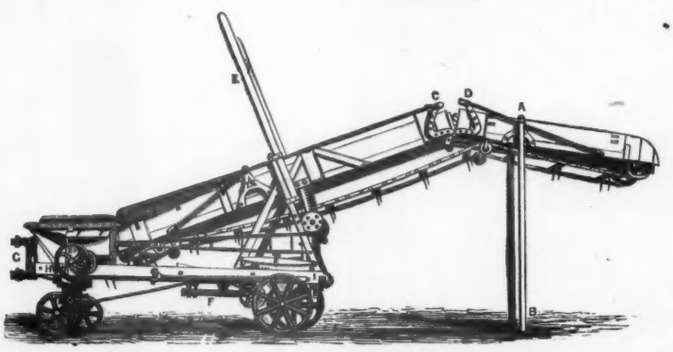


Fig. 9.

of an outer casing, formed of three segments of circles, within which perfect tubes are placed of a smaller diameter, so that an annular space is formed around the tubes. Within the tubes themselves iron rods are placed, supported at each end, so that they are centralized in the tubes, forming thus another set of annular spaces inside the tubes; the waste steam from the engine is passed through the large pipe A, fig. 6, and let escape at the point C; thus it will be evident that the three inner tubes are quite surrounded by the steam, and heated by it. The feed water enters at the point F or D, and is caused to pass through the annular space between the core rods and the inner face of the heated tubes, where it is heated to more than boiling point before going into the boiler.

Figs. 7, 8, and 9 illustrate the different views of a stacking

elevator,—in other words, a machine for raising straw or sheaves from a cart or the ground to the stack or rick being made; every maker of such machines has some pattern of his own, and that now under notice is, we consider, a very good one. It is made by Messrs. Wallis and Steevens, and they call it the "Automatic Slow-Motion Stacking Elevator." Fig. 7 shows the machine folded for travelling; figs. 8 and 9 show it in course of being raised; fig. 10 illustrates it as put in position ready for work. Although these machines differ in detail according to the practice of various makers, the principal features of all consist of a base frame on wheels, forming a "footing" when at work, and a carriage, when in transit, for the superstructure. A polygonal roller or pair of pullies above, and another pair below, distend two pitch chains, on which tires or prongs are set, and these prongs travel over a light trough, made with hinged joints, somewhat like a bagatelle board, so that when to be packed they fold down; at all events, this is the plan adopted by Messrs. Wallis and Steevens, and the unfolding or folding is effected through the medium of a pair of racks and worm-wheels; a set of arms or cranks are fitted at the joints, and united to the remoter parts of the trough by the rods, so as to truss it strongly; a part of the trough is hinged to the carriage at one end, and near the other a pair of racks, in segments of a circle, having the hinge for a centre, are affixed, and into these worm-wheels gear; so that to raise this part of the trough, all that is requisite is to turn the worm axle,—the worms act on the racks, and the first section of the trough is raised, a pair of guide standards keeping it true in line (see E, fig. 9). When this part of the trough is raised sufficiently, a pair of supporting poles (B, fig. 9) are put in position, to take the strain off the racks. As will be seen, the poles are placed, not under the carriage trough, but under that hinged to it; and after they are put in place, the carriage trough is lowered, so that the two troughs, which are hinged together, are brought in a line, and the fastening-pins put in at C D, fig. 9. Then the whole is raised to any inclination by the worms and racks; when the higher end being put over against the stack, and the lower axle being rotated, the pitch chains and pins or prongs travel upwards within the trough, and any straw, sheaves, &c. put in below are carried to the top. One principal advantage claimed by the makers for this machine lies in the fact, that when packed for storage, its extreme height is so moderate as to admit of its being pushed under any ordinary shed or suitable doorway.

HARDENED OR TEMPERED GLASS.

PUBLIC attention has recently been attracted by announcements that a method of hardening glass has been discovered, and some discredit has been thrown on the probability that the end sought for has been obtained. We have recently witnessed some experiments with the prepared glass, which place beyond a doubt the truthfulness and value of the announcements. M. de la Bastie, an engineer and gentleman of independent means, has been engaged for many years in experimenting on the possibility of rendering glass less fragile, and after much patient investigation, has at length succeeded in arriving at the solution of the problem, which he has embodied in patents obtained in France and England.

M. de la Bastie's process consists in heating the glass to a red heat, or, in the case of thick glass, to a state nearly approaching the melting point, and then plunging the article into a hot bath

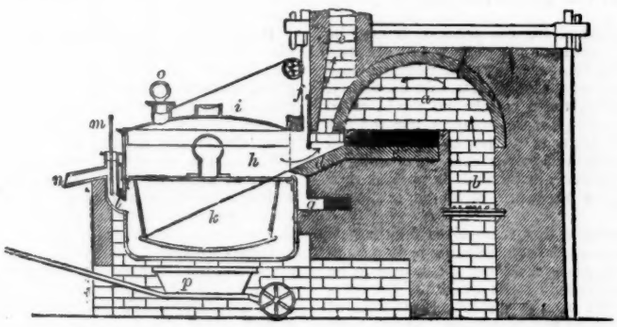


Fig. 1.

composed of materials capable of being heated to a much higher temperature than water without boiling. For this bath he employs oils and grease, wax, resin, and tar.

Some of our foreign contemporaries have been at great pains to give analyses of this toughened glass, presupposing a difference in composition from that of ordinary glass; but the method being simply a system of tempering already manufactured glass, its composition appears to play an unimportant part in the results, beyond the necessity of varying the ingredients of the bath according to the varying ingredients of the glass; any glass that could be obtained in the markets being used for the experiments.

Our illustrations are sections of the apparatus which M. de la Bastie has designed for the purpose of utilizing his invention. Fig. 1 is a section of the oven and bath, suitable for tempering shaped articles: *a* is an oven heated by a furnace *b*, having its floor *c* made in one piece of a refractory material, with a polished surface; from this a slope *d* of the same material leads into the bath *h*, which is provided with a lid *i*, for the purpose of excluding the air, and a basket *k* of fine wire gauze to receive the heated articles. At the back of the oven *a* is a chamber into which the articles are first introduced, and where they are partially heated; they are then pushed through an aperture in the dividing wall into the oven *a*, where the final heating takes place. When the temperature is sufficiently high, the ash-pit and fire-doors are closed, and rendered air-tight by luting, the fire being maintained by pieces of fuel introduced through a small aperture in the furnace door, after which the draught is stopped by closing the damper. The vertical damper *f* is then raised, which operation both causes the flame to pass by the flue *g* to a second chimney, passing along the slope *d*, and heating it, and also opens the communication between the oven and the bath, which is filled with the prepared liquid. A fire-truck *p*, charged with live fuel, heats the bath to the desired temperature. *l* is a tube, in which is a thermometer *m*, for ascertaining the temperature of the bath; by this tube also the contents of the bath may be added to; *n* is an overflow pipe. The plug *o* on the cover may be removed to observe the interior without wholly uncovering the bath. The workman watches the glass through an eye-hole, and when the article has arrived at the proper heat, he pushes it by an iron rod to the slope *d*, whence it slides down into the bath, and is received into the basket *k*. When the glass has cooled to the temperature of the liquid, the lid is removed, and the basket is taken out with the tempered glass. The function of the lid is to stop the supply of air, and thus prevent the combustion of the oleaginous liquid, which might otherwise take place on the introduction of articles raised to a red heat; the wire basket facilitates the withdrawal of the tempered articles from the bath, and, offering a yielding surface to the softened glass, the latter incurs no risk of alteration in form. A layer of sand may be substituted for the basket of wire gauze. Fig. 2 represents a modification of the apparatus for tempering sheet glass. In this the floor of the oven is made to tilt up into a line with the slope, allowing the sheets of glass to slide off into the bath.

In the experiment witnessed by us, a sheet of tempered glass about 8 in. square, and $\frac{1}{4}$ in. thick, was placed in an oak frame, so as to raise it from the floor; a 2 oz. weight was then let fall from a height of 10 ft. The weight fell the first time on the oak frame, and caused a considerable indentation in the wood; on the second trial, it fell fairly in the centre of the glass, and rebounded off, without injury to the glass. This was repeated

again and again, with the same satisfactory result. A piece of ordinary glass of the same dimensions was then taken and placed in the frame, when it was completely shattered by a 1 oz. weight let fall from a height of 18 in. Sheets of tempered glass were thrown about a large room; they rebounded, perfectly uninjured, with a metallic ring. Glass plates and watch-glasses were thrown about, with the same results. A glass dish was put on the fire and used to boil water in. A lamp chimney was put in the fire, and made hot at one end, the other end remaining quite cool, and capable of being held in the naked hand, the experiment proving the glass to be a non-conductor. A sheet of tempered glass about 14 in. long by 7 in. wide, and ⅛ in. in thickness, was laid on a frame to raise it from the floor, when it bore our weight safely, we throwing our whole weight on one foot.

Sheets of coloured glass were exhibited, showing that the treatment did not interfere with the colours; as well as specimens of plate glass highly polished. One drawback to the tempered glass is that it cannot be cut into sizes after hardening, the diamond not making an incision by means of which the glass can be separated, but producing only a scratch; the obvious course is to cut up the glass into the desired shapes

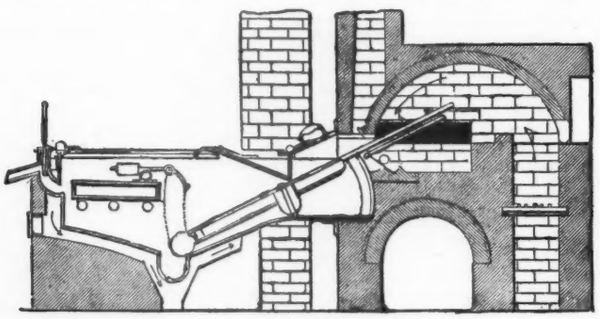


Fig. 2.

and sizes before hardening. Why should not glass for glazing be kept in standard sizes?

Among the advantages claimed for the process, it may be mentioned that, instead of increasing, it bids fair to cheapen the use of glass, as the cost of tempering is quite nominal, and will be more than compensated in the reduced weight necessary. For export trade, in particular, there can be no doubt as to which is the cheaper. In packing for the colonies, our readers are perhaps aware that a margin of 35 per cent. is allowed for breakages in ordinary goods, and 10 per cent. in sending to the continent; while the tempered glass could be packed with the same ease and certainty as hardware, of which, in fact, it becomes a mere variation.

Many uses are continually suggesting themselves for the new material. For glass roofs a considerable advantage is gained by being able to use a thinner glass, reducing the weight to be carried by the iron, and thus enabling the weight of the iron-work in its turn to be lessened; besides the important item of expenses for repairs being reduced to a minimum. It has been proposed to make our cooking utensils of glass. Enamelled glass would make the most elegant and useful of services for private houses, hotels, on board ship, or elsewhere, lending itself freely to every purpose now fulfilled by all the varieties of earthenware, porcelain, and common glass, without their perishableness. Pipes for gas is also another proposed application, also roofing tiles, tanks for the manufacture of acids, where lead tanks are now employed, the manifest advantage being in favour of the glass. An eminent brewer even suggested that glass might take the place of copper, and that our beer might be brewed in glass vats. We understand that this is actually being tried at Burton-on-Trent, with ordinary glass, but that great difficulties are encountered owing to the want of strength having to be made up for by the great weight of glass used. Another application in connection with brewing is the swan-necks used for conveying the yeast; these were formerly made in copper, but it was found impossible to properly cleanse them: glass is now being substituted with good results, but with the drawback of having many breakages—were these tempered, they would be all that could be desired; we believe there are about 50,000 of these swan-necks in Burton. In substituting glass for lead or copper, a not inconsiderable item will be saved in outlay of capital. Examples might be multiplied almost infinitely, and every one may suggest new applications of this useful invention,—we believe it might be used with advantage to improve pavement lights, which would have greater transparency with less weight and more durability. For miners' lamps the invention will be invaluable, while for such purposes as the Arctic Expedition, just about to leave our shores, the saving both in cost and storage would be something enormous. We will suppose that the expedition carries 40 lamps, for these it will be necessary to provide one glass chimney for each day that the expedition is away, and as the time is stated to be at least two years, the number of glass chimneys to be provided and stowed away amounts to the enormous number of 29,200; on the other hand, if chimneys of tempered glass were provided, a margin of three to each lamp—120 chimneys in all—would be ample.

It is interesting to notice the change in the structure of the glass produced by the process of tempering; together with the fragility, the characteristic fracture disappears, the tempered glass, when its coherence is destroyed, crumbling into coarse granular particles with rounded edges.

The "Salut Public," Lyons, gives an account of some experiments lately carried out at the railway station of Point d'Ain at the request of the authorities of the railway company, in order to satisfy them of the value of this invention, which naturally would be of the highest importance to them, were it possible to render less liable to breakage the glass roofs, the repairs of which form a serious item in the expenditure of railway companies. A sheet of common glass 6 millimetres in thickness, held in a wooden frame, was placed on the floor of a room, and a brass ball weighing 100 grammes was let fall on it from a height which gradually increased until the glass was broken by the shock. It was found that falling from a height of 24 centimetres the glass was shattered by the ball. A sheet of prepared glass only half the thickness—viz., 3 millimetres—was then placed in the frame, and the same weight was allowed to fall upon it, the height being gradually increased, but without effect, even when dropped from the ceiling of the room. The experiment was next continued out of doors, and it was not until the weight had been dropped from a height of 5·75 metres that the plate of glass was broken. Dropped on the ground, a sheet of the prepared glass rebounded slightly, and with a sound like that of metal. Another experiment was made with a view to test its resistance to fire. A slip of common glass was held in the flame of a lamp, and at the end of twenty-four seconds it snapped in two. The same was repeated with a slip of the prepared glass, but the flame had no effect upon it; and even after plunging the heated glass suddenly into cold water the glass was not broken.

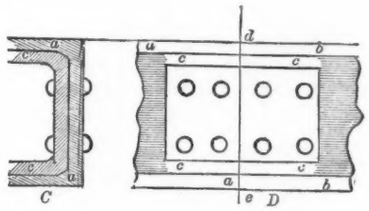
Our thanks are due to Messrs. Abel Rey and Brothers, of 29, Mincing Lane, the agents in London of M. de la Bastie, for their kindness in showing us the specimens, and affording us interesting information. We understand that arrangements are being made to carry out the process on a commercial scale.[1]

[1] The following, from "Nature," 15 April, 1875, which quotes from the "Kölnische Zeitung," 25 March, 1875, almost reads like an infringement of M. de la Bastie's patent:—"In Silesia, where repeated experiments have tested the qualities of the De la Bastie 'Hardened Glass,' another new glass was invented a few days ago, by MM. Lubisch and Riederer, at Count Solm's glass-works at Andreashütte, Klitschdorf, near Bunzlau. This glass, which the inventors call 'metal glass,' is so hard that when a pane lies on the ground, and a leaden ball of 40 grammes weight (about 1½ oz.) falls upon it from an elevation of 12 ft. it receives not the slightest impression; nor is it in the least affected when dipped whilst red-hot into cold water. Window-panes, lamp cylinders, and other articles of domestic use made from this metal glass can therefore almost be denoted as unbreakable."

THE PRACTICAL NOTE-BOOK OF TECHNICAL INFORMATION USEFUL TO STUDENTS AND WORKMEN.

(97.)

THE Elements of Iron Construction.—In continuation of the illustrations showing methods of joining iron work together, we give in fig. 550 one illustrating the junction of two lengths of "L" or "channel" iron, of which, in fig. 550, at A we give a section, at B an elevation of inside of same. In D we give the inside elevation of two pieces, *a a*, *b b*, joined by the "covering piece," *c c*, of the same, but of less section, they being riveted to the two lengths, *a a*, *b b*, as shown. *D e* is the centre line of junction. In *C* is cross section of the joint in *D*. In a former note we gave various illustrations of the methods in use for joining lengths of plates by flat covering pieces, as *a a* in fig. 551, joining the two lengths *b b*, *c c*. When the ends of the covering piece, as *a a*, are made at right angles to the length, or cut square off, as at *d d*, the corners are apt to turn up, and tend to weaken the joint. This tendency to curling up is greatly lessened, if not wholly prevented, by cutting off the corners, so as to make the end of *a a* angular, as at *e e*, or by curving the end, as at *f f*. Continuing our illustrations of Beam work, we give an arrangement by which a very strong beam is made out of comparatively weak wrought-iron "I" beams, as *a a*, fig. 552. These are embraced transversely at intervals by wrought-iron straps, *b b b b*, and tightened up by diagonal pieces, *c c*, *d d*, and a cross screw bolt and nut, *e e*, is added. This arrangement is one which could be easily adopted in districts where labour



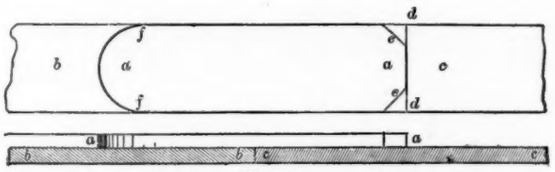


Fig. 551.

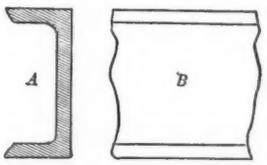


Fig. 550.

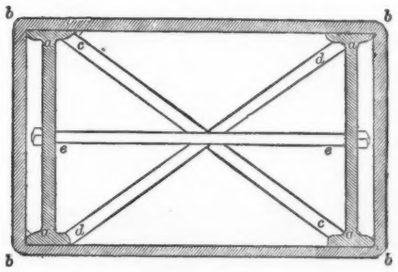


Fig. 552.

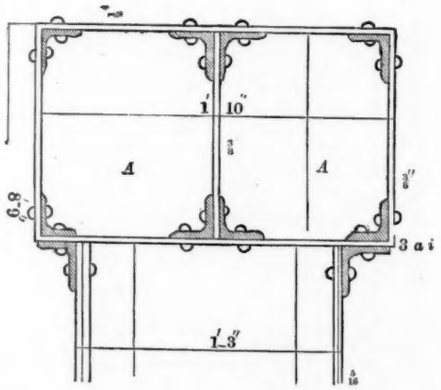


Fig. 553.

could not be had, as there is no rivetting as in "built beams;" and the work of fitting is reduced nearly to a minimum. We have in a previous note already illustrated a box beam; in fig. 553 we give part cross-section of side girder on the box principle of a railway bridge erected over the River Medlock, near Manchester, on the London and North Western Railway, of which the total length of beam is 108 ft., the span being 100 ft., the distance being 12 ft. 6 in. between the centre and side girders (the illustration is part of one of the side girders, illustrating the upper part of the beam which has double cells; the bottom part of the beam is not cellular, but made up of plates, as in fig. 554). In fig. 555 is part elevation of the upper portion *A A*, fig. 553; and in fig. 556, at *a a*, part elevation of lower part of 554 at *B B*; *b b* on fig. 556 being part plan. The rails are carried by transverse girders made also upon the box principle, but single, as illustrated in a previous note. These cross girders rest upon and are riveted to the lower flange of the main girder, as fig. 553. In railway and other large works, as road bridges, open beams are now largely used. These beams, known as "lattice" and "trellis" girders, are made up of flat bars, in conjunction with angle and T irons, so that the whole of the parts are freely exposed to the air, and can be painted with much greater facility and kept freer from rust than the closed box beams. We give illustrative sketches of one of these open beams as applied to a bridge, of which fig. 557 is part elevation; the upper and lower parts *a a*, *b b*, are made up of plates, as will be hereafter illustrated. The upper and lower plates are connected at intervals

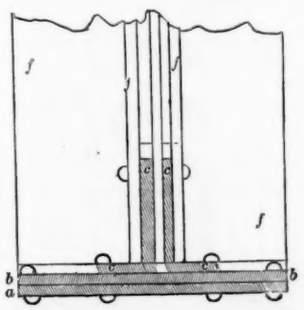


Fig. 562.

by upright or vertical T irons *c c*, *c c*, these being connected by diagonals, as *d d*, *e e*, crossing from each pair of verticals, and these being again crossed by other diagonals, as *f f*. This

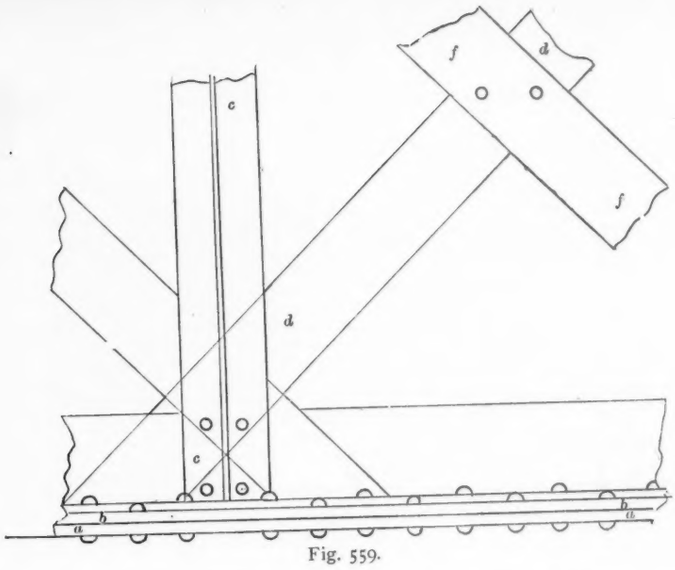


Fig. 559.

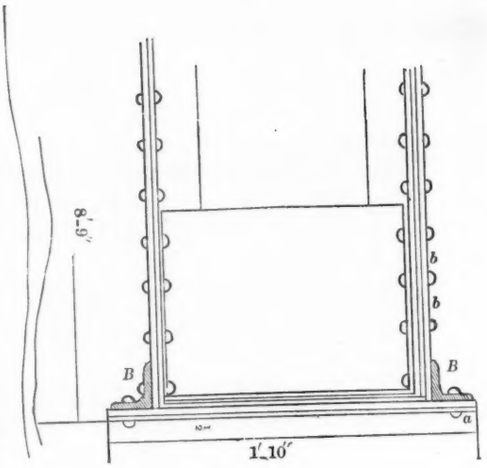


Fig. 554.

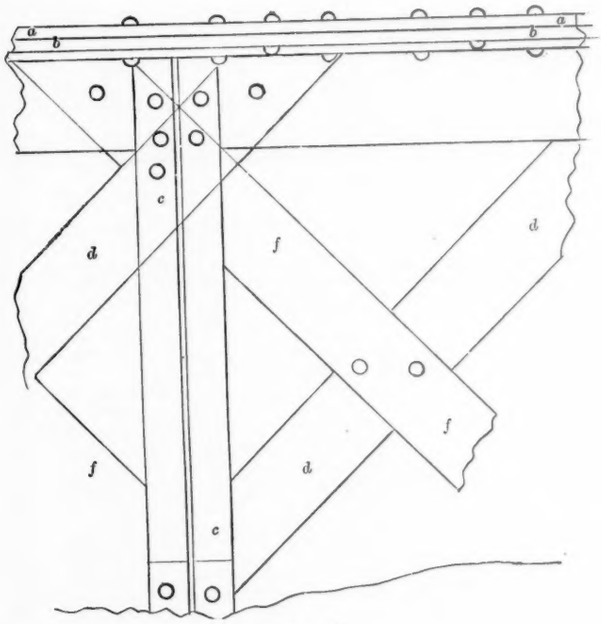


Fig. 560.

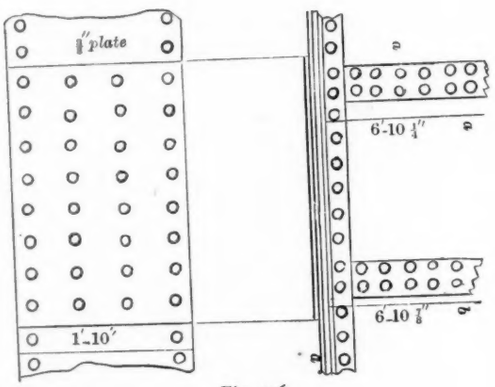


Fig. 556.

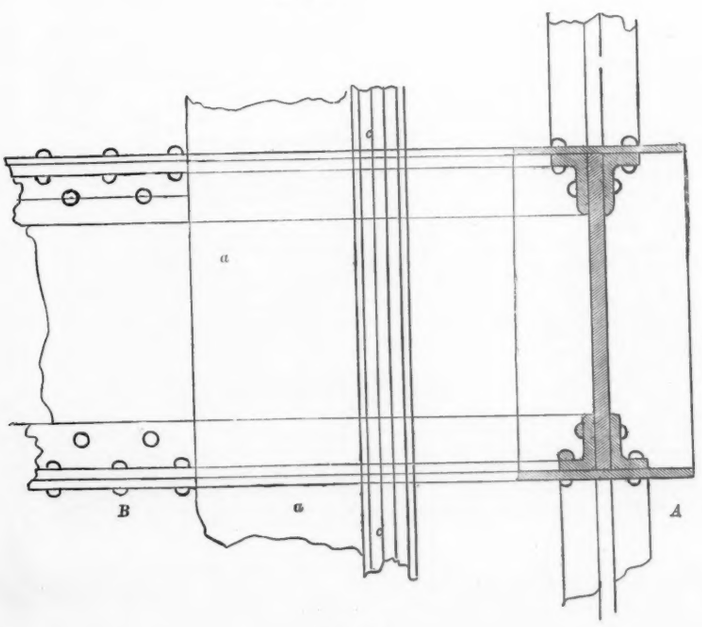


Fig. 564.

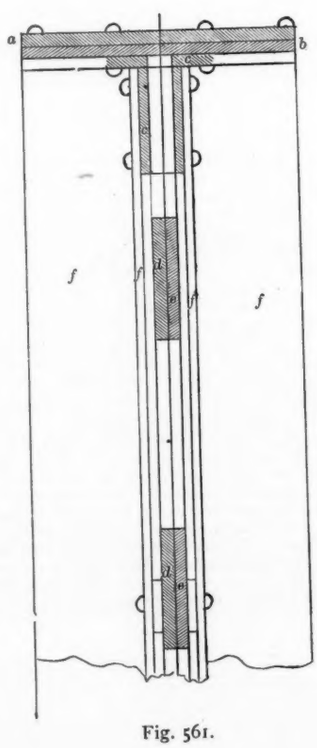


Fig. 561.

arrangement forms what is properly called a "trellis" girder. The arrangement of the bars in a "lattice" girder will be illustrated in a future note. In fig. 558 we illustrate part of the plan of fig. 557, in which *a a*, *a' a'* are the lower beams, corresponding to *b b* in fig. 557. The opposite beams are strengthened by cross beams *b b*, and diagonals *c c*, *d d*; these support or carry the sleepers *e e* for the rails. In fig. 559 we give part of side elevation of one of the girders, as *a' a'*, fig. 558, showing the upper part, as *a a*, fig. 557; *a a*, *b b* the plates; *c c* the vertical angle irons, corresponding to *c c*, fig. 557; *d d* the diagonal bars,

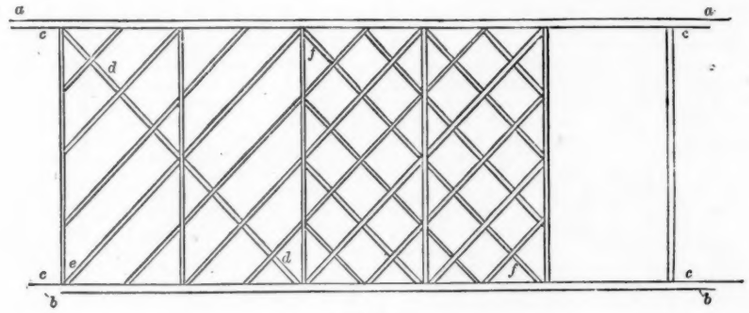


Fig. 557.

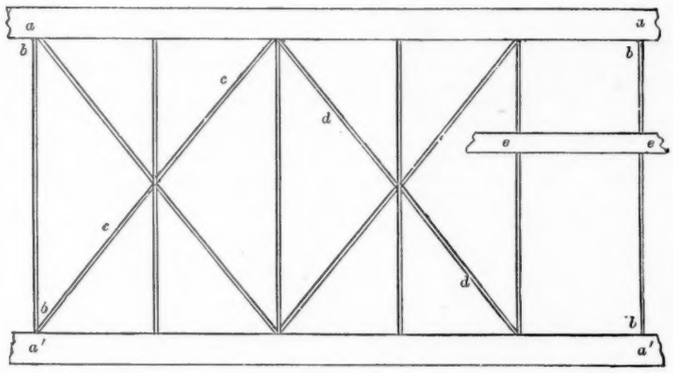


Fig. 558.

corresponding to *e e*, *f f*, and to *f f* in fig. 557. In fig. 560 we give the lower part of the side elevation of girder, corresponding to *b b* in fig. 557, the letters in this correspond to those in fig. 559. In fig. 561 we give part cross section of the girder at upper part, as in fig. 559: *a b* are the plates, *c c* the angle irons, *d e* the diagonal bars, *f f* the T irons (see *a a* in fig. 563). In fig. 562 we give cross section of the lower part of girder in fig. 560. The letters correspond to those in fig. 561. In fig. 563 part sectional plan is given at *A*, and part plan of the upper plate of figs. 559—561 at *B*. In *A*, *a a* are the T irons, corresponding to

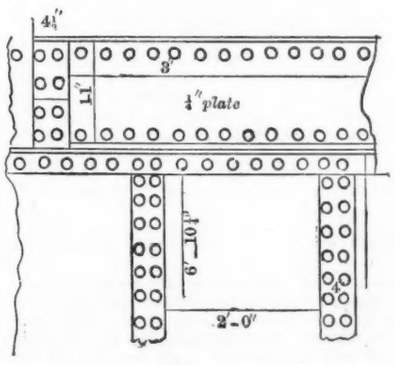


Fig. 555.

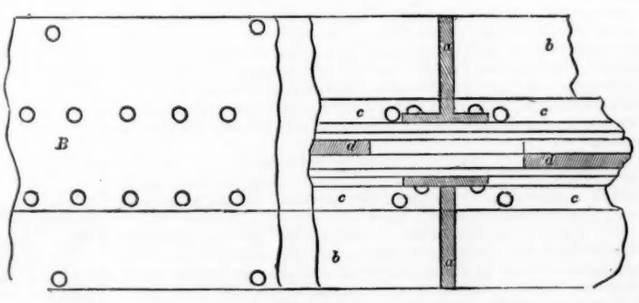


Fig. 563.

c c, figs. 557—560; *b b* the plate, corresponding to *b b* in fig. 562; *c c c c* the angle irons, corresponding to *c c* in fig. 562; and *d d* the diagonal bars. In fig. 564 we give at *A* part cross section of one of the side girders, and at *B* part elevation, showing the connection between them and the cross girders (corresponding to *b b* in fig. 558) carrying the rails. In fig. 564 at *A* the cross girder is of the class known as the "built beam," of which, in a previous note, we have described the construction. This is secured by plates, as *a a* in *B*, to the side girder *c c*.

PREVENTION OF SCALE IN BOILERS.—INUTILITY OF GLYCERINE.

IN a rather amusing paper lately communicated to the Industrial Society of Rouen, M. C. Benner, an old-established manufacturer of Darnétal, relates his forty years' experience in a locality where the water is highly surcharged with lime, of the various methods proposed for the prevention of scale in boilers. One of his earliest recollections of the subject, he states, is seeing children's broken toys put into a boiler at Mulhouse for the purpose. The friction of the wooden fragments against the sides of the boiler was supposed to prevent the deposition of scale. *Metallic filings* were afterwards employed, which, the mechanicians said, would be much more effective. Whether they proved so, M. Benner had no experience. Then came *potato pulp*—potatoes were cheap in those days, when the murrain was as yet unknown. Each time the boilers were washed out a lot of potatoes boiled down to a pulp was put in. M. Benner, whose works were at one time supplied from a well the water of which contained 0·230 grammes carbonate of lime per litre, besides traces of sulphate of lime, but no organic matter, has employed this method, and finds it tolerably efficacious. So long as the boilers are cleaned out frequently, it renders the deposit decidedly less adhesive. How the potatoes act it is difficult to explain; probably, the starch, which is at first coagulated in the cooking, and is afterwards converted into dextrine by long boiling under a pressure of 4 or 5 atmospheres, exercises a sort of disintegrating action on the carbonate of lime, rendering it more permanently pulverulent. *Oaken chips* placed in the boilers have also a good effect. Their tannin forms a calcareous lac with the lime, and mechanically also they prevent the adhesion of the deposit.

About the year 1846, the use of the residua of *dye-wood extracts* was proposed. Several kilogs. of the tarry matter thrown down by extract of Campeachy wood, which is rich in hematoxyline, dissolved in hot water and put in the boilers, were found to have a useful effect. One drawback existed, however, when the steam was used for dyers' purposes—the smallest admixture of water containing hematoxyline with the steam injured the colours.

Campeachy-wood saw-dust placed in the boilers was found to prevent the adhesion of the mud, and to keep the boiler plates satisfactorily clean. At this time M. Benner tried a cheaper remedy—*fuller's earth* mixed with water and placed in the boiler. His idea was that the particles of lime would thus be prevented from forming the nuclei of further deposition. The dose was increased at every cleaning, but although the hammer was not so often in request at cleaning time, the boilers were not in a satisfactory state. Having somewhere read that *plumbago* was an efficacious remedy, M. Benner had his boilers thoroughly cleaned and coated inside with a mixture of wax and black-lead, which, when dry, was "shined" with a brush. At next clearing the scale was less adhesive than it otherwise would have been; but the results, whatever they might have proved with a new boiler, were never found altogether satisfactory with old ones.

Herring-brine was now tried, which was to form chloride of lime and sulphate of soda by a double decomposition of bi-carbonate and sulphate of lime in the water, whilst the gelatinous matter in the brine was to prevent the adhesion of the deposits formed. It was tried in varying proportions without any good result. *Molasses* was next employed, without any better results. The scale was not very abundant, but it was sufficiently adhesive to necessitate the use of the hammer. M. Benner then tried *carbonate of lime* in various proportions without any perceptible effect.

At this time alterations were made in his works, allowing the water to be taken from the River Rebec, which contains on an average only about 0·222 grammes per litre of carbonate, with traces of sulphate of lime.

For a twelvemonth the boilers were worked without any addition to the water. There was no deposit requiring the use of the hammer, except just about the mouth of the feed-pipe. After that time deposits appeared, the fracture, viewed with a magnifying glass, showing plainly the days on which the boiler was not at work.

Next, M. Benner tried an *alkaline solution of catechu*. Being strongly alkaline, he argued, this soap should decompose the bicarbonate of lime in the water, converting it into an insoluble resinate, which, under the influence of the colouring matter in the catechu, would form a pulverulent deposit easily separated from the metal. His anticipations were fully realized. The broom and scraper sufficed for the removal of the scale, and the hammer was no longer heard. Once a year it was necessary to scale the boilers in the old way, as the soap when first introduced forms a scum on the surface of the water, which adheres to the upper part of the boiler and gets baked into a hard crust. At first the soap was added once a month; afterwards weekly, on Sundays. Still there was the same hard deposit requiring to be dislodged with heavy blows of the hammer. The other parts of the boilers kept perfectly clean; the boilers worked well without priming, the weight of mud taken out on each cleaning was about the same. In a word, the results were perfectly satisfactory, but for the hard scale on the upper portion of the boiler. About two years ago, M. Benner heard of M. Asselin's proposal to employ *glycerine* as a scale preventive. He determined to try it. His boilers were thoroughly cleansed, and the experiment was made by introducing glycerine of 28° B., in the prescribed proportions, three times a week, in the boilers supplying three steam generators. At the first cleaning there was very little mud, but, on the other hand, there was a considerable deposit of a very hard white tartar on the sides of the boilers. The use of the glycerine was continued, and at each cleaning the white tartar was found harder and more abundant. At the fifth cleaning the men, practised hands, employed on the work declared that nothing but the hammer would remove the *faïence*, as they called it, which nearly concealed the rivet-heads.

So M. Benner resolved to return to his own method. After three successive clearings, his boilers were in as satisfactory a state as before the unlucky experiment with the glycerine. His practical directions may briefly be summed up thus:—

The most essential point is that the boilers should not go longer than a month or six weeks without cleaning.

When the steam is not employed for dyers' work, *Campeachy wood saw-dust* may be used. Where the steam is so employed, an *alkaline solution of catechu* should be added three times a week to the water in the boilers supplying the steam generators. The latter is thus prepared—

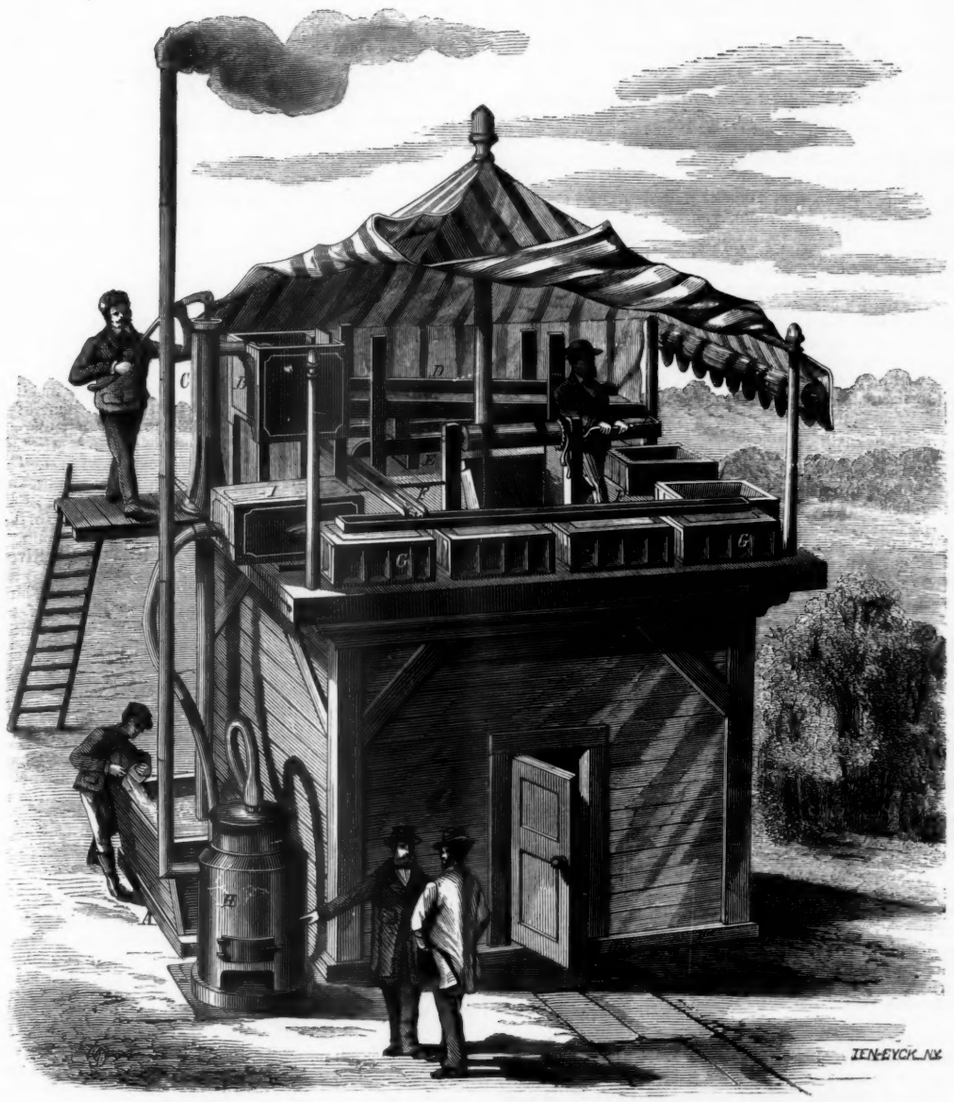
Take 4 kilogs. of catechu in squares, at 80 fr. per 100 kilogs.	3·20 francs.
Take 5 kilogs. of salts of soda of 92° at 48 fr. per 100 kilogs.	0·24 „
12 litres of water.	
Heat to 60° C. to dissolve the catechu. Allow solution to cool, and keep in a trough.	
In a boiler of 50 litres capacity, dissolve in 12 litres ofwater—	
3 kilogs. of salts of soda, as above . .	1·44 „
When the solution boils, add by small quantities—	
3·5 kilogs. of colophane, or in default, fine white rosin broken small, at 27 fr. per 100 kilogs.	0·94 „
Total . .	5·82 francs.

When the rosin is melted, and the soap boiling, the alkaline solution of catechu is added by degrees, and the whole boiled for ten minutes. We thus get 25 litres of scale-preventive for the moderate price of 5·82 fr., or about 25 fr. per 100 kilogs. In certain cases, where it may not be considered desirable to employ resinous soap, the alkaline solution of catechu may be used alone. For a boiler of 25 horse-power, 6 litres of solution should be put in after each monthly cleaning, and 2 litres every other day besides. The same quantity should be distributed amongst the small boilers supplying steam generators of like capacity. *Bulletin de la Soc. Indust. de Rouen, Oct. and Dec.* 1874.

COMBINATION ICE AND FREEZING HOUSE.

WE recently illustrated a novel plan for manufacturing ice during the winter season, which could be practised by any person owning a suitable house for the preservation of the ice. The main features of the process consisted in filling canvas tanks, supported in frames of wood or metal, with water, and allowing them to remain in a shed or freezing house until their contents were thoroughly frozen. A simple arrangement, whereby the tanks were afterwards submitted to warming by steam, allowed the ice to be readily removed in neatly shaped blocks, ready for storing.

The invention which we now present is a freezing house in which the above operation is carried on, placed above an ice



NEWSHAM, HAINES, AND HENSON'S COMBINATION ICE AND FREEZING HOUSE.

house, so that the manufacture of the ice can be carried on in the upper storey and the frozen blocks lowered at once into the receptable beneath. Above the ice house, which may be of the form shown and of any suitable construction, are erected standards for the support of roof and side awnings. At A is a large water tank which is filled from a well or hydrant, and from which the water is elevated to a regulating cistern, B, by means of the pump, C. By slightly raising the gate of this cistern, the water is allowed to pass in a thin sheet to the inclined canvas cooling plane, D, where it is exposed to the action of the cold air which freely blows through the open sides of the shelter. When the water has flowed to the bottom of the first plane it is caught by a second plane, E, which conducts it to leaders, F, by which it is distributed to the freezing tanks, G, which consist of canvas receptacles placed in frames, as above described.

When these tanks are frozen solid, a fire is made under the boiler, H, the steam from which passes through a flexible tube to the box, I. It is merely necessary to place the box over each tank for a moment to insure the loosening of the ice, when the block may be at once removed and lowered into the ice house by means of the winch shown.

Combined ice and freezing houses may thus be constructed of various sizes and productive capacities, ranging from 10 tons, suitable for private houses, to 200 tons, suitable for butchers and confectioners, and 1,000 tons and over for commercial purposes. By their use ice can be produced in any desired quantities in locations where none is to be obtained from ponds or rivers, and in latitudes where rivers never freeze over, the only care necessary being to store the ice, when made, before a change of weather can affect it. The plan, we are informed, can be used with advantage as far south as Northern Alabama. In a more southerly location, the number of cooling planes can be increased. Freezing will be accomplished most rapidly when the canvas roof and walls are removed and the uncovered tanks are free to radiate their heat.

The quantity of ice produced during a winter north of Baltimore is estimated at not less than two tons for each freezing tank 28 in. square by 10 in. deep, and the cost, we are assured, need not exceed 50 cents per ton. Two men are sufficient to fill a 1,000 ton ice house, and smaller houses of from 100 to 200 tons need not require the labour of more help than is ordinarily employed about the premises. *Scientific American.*

Practical Geology.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

COAL.—In an elaborate description of the geology of the north-eastern portion of the Salaïr range in the government of Tomsk (Memoirs of the Geological Society of Belgium, vol. i. p. 25, Brussels, 1874), M. NESTEROWSKY gives a detailed description of the large coal-field of Kousnetzk. The rocks of this coal-basin consist of very fine-grained sandstones, shales, and coal seams; they belong to the true Coal Measures. The seams are nearly all associated with the shales and vary much in dip, being almost vertical near the margin of the basin and horizontal towards its centre. They also vary considerably in thickness, one seam (known as the Holy Ghost coal) being in the centre as much as 60 metres in thickness, and thinning at the sides to six metres, or even less; this seam and some of the others also frequently split up into several distinct beds. In the Batschat region there are seven seams, including the very thick one just mentioned. To the north of Batschat the seams become more numerous and much thinner. Besides the great Kousnetzk basin, three neighbouring ones are described, viz., those of Schestakowa, Semenischkina, and Mamontowa. Of these the second is in the carboniferous limestone series, and the third in the Devonian limestones. The quality of the coals met with throughout the district is very variable, but in general they are not coking coals. In the Batschat district a *black band* has been discovered.

Coal.—The carboniferous deposits of the north of France, especially in the district of the Boulonnais, have been recently studied with much success by Professor GOSSELET, of Lille. (Memoirs of the Society of Arts, Sciences, &c., of Lille, vol. xi.) The true Coal Measures are in this area divisible into two very distinct series, viz., the grits of the plains of Hardinghem, and, above them, the coal-bearing shales of Locquinghem. In the latter beds alone are seams now worked, and much uncertainty has hitherto prevailed as to their position in the geological series, owing to the fact that the sinkings for coal passed through a well-known bed of limestone of undoubted Carboniferous Limestone age before reaching the coal-bearing shales. M. Gosselet has solved the difficulty by showing that this seemingly inverse stratification is only apparent, and is the result of a very oblique fault, which brings the older bed above the newer ones. In old workings in the Hardinghem series coal was found to be deposited in irregular *nests* in a black calcareous band. The Coal Measures of this area are shown to be the true continuation of those of Liège, Charleroi, and Mons, a conclusion which is obviously in favour of the finding of coal measures in the sub-Wealden boring.

Distribution of Ores.—In the "Journal of the Geological Society of Stockholm," vol. i. p. 175, A. E. TÖRNEBOHM treats this subject in some detail with regard to the schistose metamorphic rocks of Sweden. These he classifies as follows:—1. *Jerngneis* (iron gneiss), containing neither limestone nor ores. 2. *Grå gneis* (grey gneiss), with limestone in the upper parts, but apparently no ores. 3. *Röd gneis* (red gneiss), with limestone and ores. 4. Eurite, with oligoclase gneiss containing thick layers of limestone and ores, especially in the lower parts. 5. *Lerskiffer* (clay slate) and green eurite, &c., also with limestone and ores in its lower parts.

Iron Ores.—A. SJÖGREN is of opinion that the following groups of Swedish iron ores are of different geological ages, viz.: 1. The quartzose and felspathic ores are the oldest—they occur in connection with pure gneissic rocks. 2. The pyroxenic and hornblendic ores are of intermediate age, and are found associated with euritic rocks (felstones) and hälleflinta (felsite-schist). 3. The manganese and calcareous iron ores are the most recent. They are found in connexion with the same rocks as group 2.

The ores of the first group are striated in appearance, and are occasionally accompanied by apatite. They are seldom found in paying quantities. They are chiefly magnetic iron ore and magnetite, and more rarely hematite. The second class of ores consists of magnetite, and they are richer and purer, being usually fused without fluxes and yielding good and strong iron. The third and newest set of ores are chiefly magnetic, and are highly manganiferous and largely sulphurous.

Gold.—Mr. REGINALD MURRAY in a report on the mineral resources of Ballarat, which is incorporated in the "Report of Progress of the Geological Survey of Victoria," Melbourne, 1874, gives an account both of the auriferous quartz reefs and of the gold-bearing drift of the region about Ballarat. He distinguishes four well-defined periods of gold drift, viz.: the oldest, the older, the recent, and the most recent. The older rocks of the district are Lower Silurian, in which are the quartz reefs and granites. The same volume contains a report on the Cape Otway and Cape Paterson coal-fields by Mr. R. BROUGH SMYTH, which is of a discouraging nature, since it is stated that no workable seam has yet been opened in any part of Victoria.

Gold.—In the "Preliminary Report on the first season's work of the Geological Survey of Yesso," Mr. B. L. LYMAN, director of the survey, gives some information respecting a small area of auriferous alluvium bordering the river of the Toshibets, and also as to some smaller gold-fields. As the value of the whole is estimated as certainly not exceeding two million and a half dollars, it is not likely that these deposits will be worked on anything but a very limited scale.

Iron Ores.—In the report of the Portland meeting (1873) of the American Association for the Advancement of Science, (Salem, 1874), Principal J. W. DAWSON has a paper "On the Geological relations of the Iron Ores of Nova Scotia." He first notices the bedded ores under three heads, viz.: 1. The Great hematite bed which is found at the East River, in Pictou County, and at the upper part of Sutherlands River. This bed is 30 ft. thick, and occurs interbedded among rocks of the Lower Helderberg series, locally known as the Arisaig group. 2. The hematite and magnetic iron of Nictaux and Moose River, which occurs in bands about 6 ft. thick, in slaty rocks of Devonian age belonging to the Oriskandy sandstone group. 3. The bedded ores of the Lower Carboniferous series consist of bands of spathose iron ore or siderite, and are found near Sutherlands River, Pictou County. 4. In the coal-fields of Nova Scotia, beds of clay ironstone are frequently met with.

Under the head of veins, Dr. Dawson specially mentions the following, viz.:—1. The great specular iron veins of the Silurian slates and quartzites. In the Acadia mines, Cobequid Mountains, the so-called "great vein" of this ore occasionally reaches a thickness of 150 ft. This thickness is, however, a rare maximum, and occasionally the width of the vein dwindles to the thinnest vein or string of ankerite. 2. Next are described the limonite veins of East River, Pictou, then those of Shubenacadie, &c. . . . and 3. The magnetite and specular iron veins which occur in the triassic trap of the district.

Jade.—The late Dr. FERDINAND STOLICZKA has left a note respecting "the occurrence of this mineral in the Karakash valley, on the southern borders of Turkestan." He describes in it the old jade mines, or rather quarries, which are situated about seven miles from the Khirgiz encampment of Belakchi, which is itself about twelve miles S.E. from Shahidulla. The jade occurs in nests and in veins, cutting through metamorphic schistose rock which on weathering assume the appearance of laminated sandstone. There seem to be two varieties of nephrite or jade, viz.: "white jade," which usually is found in contact with the zeolitic vein rock through which all the jade veins run, and which rarely fills up the whole of the vein. The second variety is called "green jade," and usually occupies the central part of the vein. The pale green jade is occasionally found in veins amounting to 10 ft. in thickness, but the brighter and more translucent green jade is usually found in veins of one or a few inches, and is even then full of flaws. Since the expulsion of the Chinese from Yarkund in 1869, the jade quarries in the Karakash valley have become entirely deserted. The Chinese seem to have been acquainted with the jade of the Kuen-Lun mountains during the last two thousand years. *Quarterly Journal of the Geological Society of London, vol. xxx.*, 1874, *p.* 568.

Minerals of Newfoundland.—In the "Quarterly Journal of the Geological Society of London," vol. xxx. p. 722, Mr. JOHN MILNE gives a considerable amount of information with regard to the useful minerals hitherto recognized as existing in Newfoundland:—*Coal:* The seams appear to belong to the lower coal measures of the United States; those that are workable are chiefly developed round the north part of Grand Pond and on the south-eastern slopes of St. George's Bay; they are bituminous, dip at a high angle, and improve in quality towards the north, as do also the gypseous beds of the district. *Copper:* The chief ores of copper are the common yellow pyrites and the grey sulphide, the veins of the latter occurring most often in the slates of the Huronian series, while those containing the former are generally found associated with the serpentines of the middle

Quebec group. "In those parts which are dolomitic *nickel* is found." *Lead:* The calcareous members of the calciferous and carboniferous series are to be specially noted as most usually containing veins with lead ore. When galena is found in siliceous rocks, it is in a quartz gangue. *Gold* has only been seen as specimens hitherto, not in workable quantities, but the author says that "if the existence of a geological horizon corresponding to that of the auriferous rocks of Nova Scotia favours its presence, there is every reason to expect its occurrence in the altered portions of the intermediate system, the position and wide extent of which" is referred to in the paper. *Silver* is found with the lead ores, and also at Tilt Cave with an ore of copper. *Tin* is known to exist, but no particulars respecting it are given.

VETILLART'S METHOD OF DISTINGUISHING VEGETABLE FILAMENTS IN TEXTILE FABRICS.

By Dr. C. Roucher, Apothecary in Chief to the French Military Hospital at Gros-Caillou.[1]

A FEW years ago M. Vétillart, who is well known as the proprietor of one of the most extensive and best-managed bleaching establishments in the west of France, submitted for the consideration of the Academy of Sciences a method of distinguishing, by certain well-defined peculiarities, the several textile substances employed in French and foreign manufactures.

A Report thereupon, by M. Chevreul, was presented to the Academy at its sitting of 23rd May, 1870.

Previously, in April, 1869, the process had been referred by the Minister of War for the consideration of the Superior Consulting Committee on Dress and Equipment, who reported the result of their investigations in the February following. The details furnished by the documents just cited, and by M. A. Chevallier's "Dictionnaire des Falsifications" will enable us to show the several phases through which this important problem has passed and the stage to which it has now been brought by the diligent researches of M. Vétillart. We shall also avail ourselves of M. Vétillart's published "Instructions" for the examination of textile materials. These instructions have been published by order of the Minister of Marine, and to them we shall refer for practical details. We have also been fortunate enough to obtain ministerial permission to reproduce the illustrations appended to the said instructions, from which the explanatory references have also been transcribed.

The value of an essentially practical method of distinguishing the various kinds of vegetable fibre from one another, of detecting their admixture, and, up to a certain point, determining the proportion of each in yarns and fabrics is obvious. Its applications to the purposes of natural and industrial science, and to the requirements of the public service, of legal enquiry, and medical jurisprudence, are as manifold as they are easy to foresee.

We know that in textile fabrics of vegetable origin the admixture of flax with cotton or flax with hemp, indeed, as a rule, of any vegetable substances of different origin, is prejudicial to the strength of the stuff, as the yarns offer different degrees of resistance and thus accelerate the wearing-out of the fabric.

M. Vétillart states that the mixture most often met with is that of *flax* with *hemp*. Opinions are divided as to its ineligibility. In some localities, where mixed fabrics of this description have long been used, there is a decided prejudice against them, which must be regarded as a deduction from practical experience. If we examine the two component substances under the microscope, we find that the filaments of flax are made up of fibres, which separate without difficulty, and after constant wear and repeated washing remain separate; those of hemp on the contrary, retain their homogeneity under like treatment, and it can easily be conceived that the rough, close, angular fibres of the latter must sooner or later cut or rub through the finer detached fibres of the flax. The disadvantages of the mixture may not be at first apparent, but in the end it must turn out badly; and it is evident that the two materials ought never to be worked up together in the same way.

The mixture which is open to the greatest objection is that of *jute* with either *hemp* or *flax*. As these materials can now be worked up together, it is necessary to be able to distinguish them readily and with certainty. In some localities linen goods frequently contain an admixture of *cotton*, sometimes the warp is linen and the woof cotton, or *vice versa;* sometimes, flaxen and cotton yarns are used alternately throughout the material.

Some years ago it was found that *china-grass* and *cotton* could be worked up together into yarn. The former undergoes a thorough bleaching, and is then cut into convenient lengths, and carded and spun with the cotton. *New Zealand flax* (*Phormium tenax*) is not often met with in goods now sent into the market; but as it may come into use, it is desirable that the mode of detecting it should be understood.

These admixtures and sophistications in textile manufactures are much more common, much easier to perpetrate and much more difficult to detect, than is generally supposed, and any means of putting a stop to such frauds would be as much dreaded by a certain class of manufacturers as it would be appreciated by buyers.

The want of some such means, which is admitted by all honest traders, accounts for the repeated attempts which have long been made to achieve this desirable result; but it cannot be denied that the methods hitherto proposed have been either imperfect or uncertain in their results, or else not sufficiently practical, or, finally, limited in their application to a very few textile substances.

A glance at the principal treatises which have been published on the subject, confining our attention to the detection of materials of vegetable origin, will prove such to be the fact. The microscope has long been used to distinguish textile substances from one another.

Raspail has noticed the cylindrical shape, jointed like a sugar-cane, of filaments of flax and hemp, and adds that filaments of cotton appear as flattened, undulating ribands, twisted spirally, and having granulated surfaces. The characteristics of flax and hemp are here not distinguished.

Clerget and Lerebours have observed and formulated the differences between flax and cotton, using a microscopic power of 300 to 400 diameters, and lay stress on the distinctive characteristics of these two kinds of filaments, and also on those of silk and wool, but omit all mention of the distinguishing features of hemp.

Boettger distinguishes filaments of flax from those of cotton by means of a boiling lye of potash, which gives a decided yellow tinge to flax, but has little effect on cotton. After exposure to this test, the filaments of flax appear white or a light yellow, those of hemp a deep yellow.

The result, being dependent on differences of shade in the colour induced, is liable to error, particularly when the yarns differ in quality in regard of purity.

Kühlmann employs a concentrated solution of potash, cold, to distinguish raw cotton from raw flax. The first shrinks and changes to a light grey or dirty white; the second shrinks to a much greater degree and turns an orange yellow. This test is only applicable whilst the materials are in a raw state, and is of no use after they have been bleached.

According to Kindt, the presence of cotton in a hempen or linen fabric may be detected by first removing the sizing by boiling in water, and then steeping the material for a minute or two in strong sulphuric acid, which renders it diaphanous. The cotton threads suffer first, and are converted into a gum, whilst the linen threads are still white and opaque. A subsequent washing in potash-water dissolves out the residue of the cotton threads, and their proportion to the whole may be ascertained by counting the missing threads. This test may easily lead to mistakes, as the least undue prolongation of the action of the acid causes it to attack the linen yarns as well.

To detect the presence of cotton in linen goods, Leykauf proposes to dry the latter thoroughly, then soak them in oil, and wring them hard. The linen threads become translucent, the cotton remain white. It is not stated whether this test can be applied to hempen goods.

M. Boussingault has observed that hemp treated with nitric acid of 36°, containing a little hypo-nitric acid, turns a pale yellow colour, under heat and cold. Hemp steeped in standing water assumes a pinkish tinge.

Flax, under heat, acquires a pale pink hue, which subsequently changes into yellow. *Phormium tenax* quickly colours a blood-red, and retains this colour after steeping in lye.

Here the characteristics of flax and hemp are but imperfectly defined, and vary with the mode of steeping. The test can only be relied on for the detection of *Phormium tenax*.

Another process, suggested by M. Chevallier, to distinguish flax from cotton, consists in wetting the material with a saturated solution of sugar and common salt, allowing it to dry, and then drawing out single threads, both lengthwise and across the stuff, and burning them. Flaxen thread burns grey;

[1] "Annales d'Hygiène Publique."

cotton gives a black ash. This is an empirical test, on which it would be impossible to base any generally applicable method of proof.

Lastly, M. Vincent, assistant inspecting-apothecary of marine, has succeeded in distinguishing a great variety of vegetable fibres by the following methods :—1st. By the employment of three different chemical reagents—concentrated nitric acid, hydrochloric acid, and iodic acid. 2nd. By the combined action of an aqueous solution of chlorine and ammonia applied in succession. He has ascertained that nitric acid gives a pale yellow hue to common hemp, and a light pink tint to hemp steeped in stagnant water, as well as to flax and the fibres of the Oua-ouké, of the Agaves, of *Hibiscus*, *Lagetta*, *Crotalaria*, *Abaca*, and *Corchorus*. In some of these fibres the tint becomes very nearly red under the action of the same reagent, and in *Phormium tenax* it takes the colour of blood. Although the presence of *Phormium tenax* is thus shown, the test is not conclusive, as the ligneous and cortical fibres of the plants first specified, as well as those of several species of cocoa-nut, of *Pandanus*, *Cordyline*, *Cissus*, *Mauritia flexuosa*, *Phyllandrium aquaticum*, *Raphanus sativus*, of two Brazilian *Pastras*, &c., &c., behave almost exactly the same as *Phormium tenax*.

The colouring of vegetable fibre under the action of nitric acid is so common that *Asclepias gigantea* has hitherto been generally regarded as the only plant which is not coloured by the reagent in question. Amongst the numerous tints passing from a pale pink to a deep red, it would be difficult to fix upon the precise shades indicating the origin of different kinds of fibre or fibres of different degrees of purity.

Hydrochloric acid, applied hot or cold, colours neither flax nor hemp; at a temperature of 30° to 40° centigrade (86° to 104° F.), it gives a yellow tinge to *Phormium tenax*, which afterwards reddens, and quickly changes to brown or black.

Iodic acid has no effect on hemp or flax, but gives a pink hue to *Phormium tenax*.

The effects produced by the two last-mentioned acids are useful, no doubt, but imperfect tests.

Chlorine and ammonia applied in succession communicate to filaments of the Agaves, of *Hibiscus*, *Lagetta*, *Crotalaria*, *Abaca*, and *Corchorus* a mottled red, not nearly so intense as that assumed by *Phormium tenax*. On *Bœhmœria* and *Asclepias* they have no effect. This test, which has been found useful in examining canvas for nautical purposes, does not enable us to distinguish *Phormium tenax* conclusively, as jute (*Corchorus capsularis*), treated in the same way, acquires a red colour, almost identical with that of *Phormium*. Besides, the results are not so well marked when the material has been bleached rather more than usual. Notwithstanding the incontestable value of M. Vincent's experiments, and the decided advance thereby made in the art of distinguishing the several textile fibres in common use, they do not satisfy all the requirements of this complex and difficult problem.

We shall now see how, after painstaking and prolonged research, M. Vétillart has treated the same subject, and with what results.

We all know that textile substances, in most cases, are made up of microscopic fibres of extreme tenacity, very short, sometimes single, sometimes in clusters, which are extracted from the plants producing them by certain processes designed to destroy or remove, more or less thoroughly, the extraneous substances with which the said fibres are surrounded or impregnated.

The fibres themselves are hollow, and the central cavities running through each longitudinally vary in diameter. The walls also vary considerably in size and shape. The rudimentary filaments terminate, either in a more or less blunt point, or in a more or less marked enlargement. The length and external appearance of the fibre, the size and shape of the central duct, as shown by a transverse slice of fibre placed under the microscope—these are so many distinctive signs, which can easily be detected with suitable microscopic power, and which are the more useful and reliable, inasmuch as they are generally common to all plants of the same family, of which they may be regarded as a characteristic.

With microscopic investigation M. Vétillart combines the use of a very simple chemical test, giving either one or other of two results so opposite that it is impossible to confuse them. According to the nature of the fibre the application of sulphuric acid and iodine produces a *blue* or a *yellow* colour. These colours are bright and well-defined, without gradations of tint that might give rise to uncertainty.

They are observable in the length as well as in the cross-section of the fibre, and their arrangement in different species supplies additional means of distinguishing the latter. The textile substances in most common use in the present day are six :—flax, hemp, cotton, jute, China-grass, and New Zealand flax (*Phormium tenax*).

These six materials have been the chief objects of M. Vétillart's experiments.

Raw fibres should be left for half an hour in water containing a small proportion of carbonate of soda, and afterwards washed.

Dressed fibres should be washed in distilled water or in boiling water containing a little alkali.

Dyed fibres should have the colour taken out of them as thoroughly as possible.

Taking up a pinch of the fibres thus prepared, and about 1½ in. or 2 in. in length, we draw out a few; we arrange them lengthwise, separately and evenly, under the microscope, at the same time wetting them with some liquid, as glycerine or chloride of lime, so as to render them transparent; and we cover them over with a thin slip of glass.

In preparing the iodine we mix 1 part of iodide of potassium with 100 parts of distilled water, and add iodine to the solution.

After wetting the filaments for a few minutes with a drop of the solution, the surplus moisture is removed with a piece of filtering paper, and the glass laid over again. Under one end of the glass we introduce a few drops of sulphuric acid suitably diluted with water or glycerine, and as the excess runs out from under the opposite end of the glass it is removed with filtering paper. In this way we get rid of the excess of iodine.

The sulphuric acid must not be too strong, because then it would dissolve the cellulose, causing it to swell, and throwing the preparation out of shape; on the other hand, if too much diluted, it will have no effect at all on the cellulose. We have found the following receipt give the best results :—

Mix in a flask 2 parts of Price's glycerine with 1 part of distilled water; stand the flask in cold water up to the level of the fluid within it, add, by degrees, with great care, and constantly agitating the flask, 3 parts of common sulphuric acid of the ordinary strength of 60°. Continue the agitation of the flask until the contents are thoroughly mixed; allow them to cool. Then stand the flask aside to settle, and afterwards decant the liquor into glass bottles with ground-glass stoppers.

To examine cross-sections of fibre, we take a small bundle of filaments about an inch long and as big round as an ordinary goosequill, tie it in the middle with thread, and dip the ends into an adhesive mixture, with a gelatine base compounded as follows :—

Dissolve one part of the very best mouth glue in a pint and a half of water. Whilst the solution is still warm add one part of glucose of the consistency of honey. When the admixture is complete, pour into wide-mouthed glass bottles holding at most 100 grammes each (about 3½ oz.), and put in each a small piece of camphor to prevent the formation of mould. As it cools the mixture solidifies; and when required for use it should be stood in front of the fire or in a sand-bath to melt it again.

The mixture should be well worked into the fibres with the fingers, dipping first one end and then the other. The filaments should be rubbed lightly to and fro between the fingers, so that every portion may be moistened alike. At the end of twelve hours, when the fibres are dry, we place the bundle in the grip of a hand-vice, and with a sharp razor shave off the thinnest possible slices at right angles to the axis, and lay them on a slip of glass ready for the microscope.

The filaments thus treated should have undergone a previous washing in lye or a certain amount of bleaching. When raw they should be first boiled in a solution of soda or potash containing 5 to 10 per cent. of alkali, and afterwards washed very carefully, and thoroughly dried.

Again, we take a strand of fibres prepared as above, and work them hard between the fingers, so as to separate them and bring out certain minor peculiarities by the flexure of the fibres. We lay a few single fibres drawn out of the portion which has been most thoroughly disintegrated on the middle of a slip of glass, wet them with iodine for some seconds, absorb the excess of iodine with blotting-paper, lay another slip of glass over them, and add sulphuric acid in the manner before described.

The characteristics presented by the several kinds of vegetable fibres will be as follows :—

FLAX.—A. Filaments formed of clusters of fibres, easily separated with the point of a needle.

These fibres are ⅛ in. to 1½ in. long and over, of uniform diameter, and pointed at their extremities.

Central duct very narrow.

They are smooth; the creases produced in the fibre by working them between the fingers are indicated usually by crossed lines. The fibres taken from the foot of the plant-stalk are broad and striated.

They colour blue under the action of iodine and sulphuric acid, sometimes becoming dark as the lees of wine. The central duct shows yellow; the granular substance with which it is filled possessing that property.

B. The cross-sections present the appearance of clustered polygons, having little mutual coherence.

They colour blue, with yellow centres.

The filaments have little coherence. It is owing to the uniformity of these diameters and their smooth surfaces that it is possible to spin them into the finer kinds of thread.

HEMP.—A. The fibres are strongly coherent, and each is indued with an envelope of thin membrane, which turns yellow instead of blue under the action of iodine. They are nearly as long as the fibres of flax; but their diameters vary, and they are thicker and not so smooth as those of the former.

The tips are short, thick, and spatula shaped.

They take a blue or bluish-green colour with iodine and sulphuric acid.

B. The cross-sections differ widely from those of flax; the fibres may be described as entangled together; their mutual coherence is very great.

Each fibre takes a blue colour, with a yellow outer margin and yellow centre.

The coherence of the fibres, the inequality of their diameters, and their rigidity, render it impossible to work them up into finer kinds of yarn.

COTTON.—A. Fibres isolated, twisted, taking the shape of ribands, with their margins rolled longitudinally, and the central portions plaited.

Tips large. A central duct. Colour blue with iodine and sulphuric acid.

The fibres of *long staple* cotton are ·7 in. to 1·2 in. in length; those of *short staple* cotton ·3 in. to ·7 in.

B. Cross-sections, single, round or uniform.

Colour blue, with yellow patches on the exterior and interior.

JUTE.—A. Fibres strongly coherent, with undulated edges; difficult to separate; ·04 in. to ·15 in. in length.

Central duct large, irregular in its size, empty.

The fibres have broad, rounded tips, and take a more or less deep yellow colour.

B. Cross-section strongly coherent. Rectilinear polygons, resembling those of flax, but with larger central orifices.

Turn yellow, the shade deepening towards the margin of each polygon.

Much-bleached jute turns a dirty white or greenish hue.

Damp separates the fibres; and the strands cannot be knotted, as they break—peculiarities which limit the use of the material.

It will not bear lessivation.

CHINA-GRASS.—A. Longitudinally, the fibres appear single and of variable size, sometimes very large; the central duct is frequently filled with granular matter, which colours yellow; often obliquely striated; 1·3 in. to 3 in. in length, whilst the fibres of hemp rarely exceed 1·8 in.

Colour blue.

B. Cross-sections very irregular, with re-entering angles, and displaying little coherence.

Central cavity large, and colours a brownish yellow.

The cross-sections are larger than those of the other materials specified; they take a blue colour resembling those of hemp.

The admixture of *China-grass* with *cotton* is not to be recommended.

PHORMIUM TENAX.—A. Vascular aggregations of leaflets readily divisible with the point of a needle into fine, rigid, regularly-shaped fibres 1·3 in. to 3 in. in length, each with a central duct of uniform width.

Edges rolled longitudinally.

Tips fine and gradually tapering.

Take a yellow colour, deeper in proportion as the material is whiter.

B. Cross-sections analogous to those of jute, but with the angles of the polygons rounded.

Central cavity large and circular; takes a yellow colour.

Like jute, the material dislikes damp; and like it, too, will not bear lessivation.

It has long been known that the substance of which vegetable fibre is composed, *i. e. cellulose*, after a due amount of exposure to the action of sulphuric acid of suitable strength, will colour under iodine. But the phenomenon is oftentimes fugacious and difficult to obtain. M. Vétillart has succeeded in utilizing it as a prompt and efficacious test, certain in its results, and perfectly easy of application. His researches have shown that the lines observable in vegetable fibre are accompanied by the presence of membranous or granular substance, which, under the aforesaid treatment, assumes either a blue or a yellow colour.

The relative disposition of this substance and the cellulose in each fibre indicates its peculiarities of structure, and gives to it certain specific characteristics.

Some idea of the accuracy thus attainable may be afforded by giving the results of some experiments made in the writer's presence. A certain number of samples of textile materials, some single and others mixed, were sent to M. Vétillart, who, without knowing what they were, pronounced on the nature of each sample and the approximate proportions of the several mixtures, with marvellous correctness, as the annexed table will show :—

No. of Experiments.	Nature of Sample submitted.	Verdict of M. Vétillart.
2	Jute yarn.	Jute.
5	Hempen yarn, grey, hackled.	Hemp.
6	Do. Brioley d'Anjou, do.	Hemp.
8	Russian flax, raw.	Flax.
9	Belgian do., dressed.	Flax.
10	Tow, dressed flax.	Flaxen tow
17	Grey hemp and raw Russian flax.	Mixture of hemp and flax, in proportion of $\frac{3}{4}$ flax to $\frac{1}{4}$ hemp.
18	Jute and Russian flax, equal parts.	Mixture jute and flax, $\frac{1}{2}$ and $\frac{1}{2}$.
19	Jute and grey hemp.	Mixture jute and hemp, in proportion of $\frac{1}{3}$ hemp and $\frac{2}{3}$ jute.
20	Grey hemp and Belgian flax, equal parts.	Hemp, $\frac{1}{2}$; flax, $\frac{1}{2}$.
21	Brioley hemp with a little Belgian flax.	Hemp, $\frac{9}{10}$; flax, $\frac{1}{10}$.
22	Jute and Brioley hemp.	Hemp, $\frac{1}{2}$; jute, $\frac{1}{2}$.
23	Jute, Brioley hemp, and Russian flax, equal parts.	Hemp, $\frac{1}{3}$; jute, $\frac{1}{3}$; flax, $\frac{1}{3}$.
24	Best flaxen yarn, flax, and best yarn from wild hemp.	Mixed yarn, $\frac{1}{2}$ hemp, $\frac{1}{2}$ flax.
25	Best yarn from wild hemp, with a very little flax.	Hempen yarn, nearly pure, containing a few strands of flax, the quantity of which is scarcely appreciable.
3	Manilla yarn.	Fibre of a certain species of banana.
4	Pita yarn.	Fibre of yucca.

To form a correct estimate of the two last decisions, we must bear in mind, 1st, that *abaca*, or Manilla hemp, is obtained from *Musa textilis* (Manilla plantain) and *Musa paradisiaca* (common plantain); 2nd, that *pita*, *i.e.* the fibre of the American aloes, is generally regarded as a product of *Fourcroya gigantea*. Thus, of the whole seventeen decisions, only one was not in accordance with the alleged origin of the sample.

This discrepancy has called forth some observations from M. Vétillart, which are not without interest. He says :—"Under the name of *pita* are designated the fibres of various species of agave, amongst others those of the *Agave Americanus* and *Fourcroya gigantea*. I possess samples of the fibre produced by the latter, and by several species of agaves. They present generic peculiarities characteristic of the Amaryllids, but they differ entirely from those of sample No. 4. Judged by its characteristics, the latter can only be placed amongst the Lilies. Of this family I possess three sets of specimens : *Phormium tenax*, *sancinera* (several species), and *yucca* (several species). Sample No. 4 does not correspond with either of the former, and I maintain that it has been obtained from a *yucca*, of which it has all the characteristics, except that the diameter is rather larger than those of my specimens. I have no doubt that it belongs to a plant of the same genus."

In view of the unquestionable authenticity of the samples placed in M. Vétillart's hands, and the various and sometimes doubtful origin of the substance known as pita, we need not hesitate to admit that truth would lie on the side of the observer, armed with a rigorous method of test.

It will be seen by the foregoing that M. Vétillart's researches have not been restricted to the six textile fibres now most employed for industrial purposes.

In accordance with the wishes expressed by the Commission appointed by the Academy of Sciences, he extended his experiments, so as to include a great variety of other vegetable substances. For this purpose he had recourse to the collections in the museum at Paris, and to those in the Conservatoire des Arts et Métiers. During a visit to England, also, Mr. Oliver, the keeper of the herbaria at Kew, placed at his disposal a great variety of textile substances, whose origin was perfectly well known. On 1st January, 1870, M. Vétillart had arrived at the conclusions shown hereunder :—

Textile fibres treated successively with solutions of iodine and sulphuric acid, suitably diluted with a mixture of water and glycerine.

Class A. Turn yellow.

(*a.*) *Monocotyledons.*—Musaceæ, Liliaceæ, Palmæ, Pandanus, Amaryllidæ, Arvidæ, Typhaceæ, &c., &c.

(*b.*) *Dicotyledons.*—Malvaceæ, Liliaceæ, Thymelaceæ, Cordeaceæ, Butnereaceæ, Salicineæ, Compositæ, Anonaceæ, Myrtaceæ, Bombaceæ, &c., &c.

Class B. Turn blue or violet.

(*a.*) *Monocotyledons.*—Graminiæ, Bromeliaceæ.

(*b.*) *Dicotyledons.*—Lineæ, Cannabineæ, Urticeæ, Leguminosæ, Moræ, Asclepiadeæ, Polygaleæ, Cinchonaceæ, Artocarpeæ, &c., &c.

"The researches of M. Marcel Vétillart," observes M. Chevreul, "undertaken originally with a view merely to their industrial application, through the manipulative skill and inductive ability of their originator, have acquired a real scientific importance. It certainly is not uninteresting to know that this persistency in the forms of vegetable fibre suffices to enable us to distinguish six different manufactured substances one from another."

For our part we shall be satisfied if the foregoing remarks tend in any way to popularize and extend the practical application of a method of analysis as simple as it is ingenious and precise.

Description of the Filaments as viewed under the Microscope.

Flax.—(*a.*) *Transverse sections of the stem.*—Polygons with projecting or slightly rounded angles, of a more or less deep blue or violet of different shades. In the centre of each section is a yellow spot, marking the central cavity of the fibre, generally very small, rounded, and filled with granular substance. The parenchym, the epidermis, and all other portions which are not composed of *cellulose* alone, take a more or less deep yellow tint.

Sections of *raw* flax generally appear in clusters. In proportion to the dressing the material receives, the detached sections become more numerous.

(*b.*) *Transverse sections at the "collar."*—Irregular shaped sections, with rounded and sometimes re-entering angles; the central cavity large; the walls comparatively thin; may be distinguished from sections of *hemp* by the following characteristics:—the edges of the polygons are not in close contact or interlaced; their perimeters are not marked by a yellow rim, but there is a yellow granular deposit in the centre of each, which is not found in hemp.

(*c.*) *Fibres viewed longitudinally.*—Isolated, full, smooth, transparent, of uniform diameter for considerable length. Colour usually a rather pale blue, with crossed transversal lines of deeper blue marking the enlargements in the fibre. Down the middle is a thin yellow line, produced by the granular deposit in the central duct of the fibre.

(*d.*) *Points of the stem fibres.*—Fine and pointed like needles.

Hemp.—(*a, a'.*) *Transverse sections.*—Cross sections of fibres of hemp appear under two distinct forms: firstly, clusters of polygons with salient angles and rectilinear sides, like sections of flax (*a*); secondly, irregular figures of angular or rounded contour making close contact with one another at their re-entering angles (*a'*). The central orifice never shows any yellow deposit of granular matter. These sections appear a blue or violet of many different shades. Where the hemp is raw or but little bleached, the sections are characterized also by a yellow rim running round each section.

(*b.*) *Fibres viewed longitudinally.*—Those taken from samples which are in a raw state, or have been but little bleached, have a thin yellow envelope. The isolated fibres have very little transparency and vary much in diameter; sometimes they are smooth and pale; more often they are deeply channelled; many are flat and riband-like. There is very little yellow deposit in the central duct. Transverse lines are observable on their surfaces, as in flax, but they are very slight and are not indicative of enlargements in the fibre. In some specimens the *fibrillæ* show a disposition to detach themselves from the fibre, which is never the case with flax.

(*c.*) *Points of the Fibres.*—These are generally flattened, narrow one way and comparatively broad the other, rounded at the extremities, and of various shapes, resembling a spatula, a spear-head, or some irregular figure.

Jute.—(*a.*) *Transverse Sections.*—Closely grouped clusters of a more or less deep yellow colour, varying with the thickness of the slices submitted to examination. The sections are formed of rectilinear polygons, with well-marked angles, closely agglomerated. The central openings are round, with smooth margins, perfectly hollow, and generally large by comparison with the diameter of the polygon. In very thin sections, a very narrow marginal line of a deeper yellow is observable. Very white jute does not colour in so decided a manner, but assumes a dirty greenish hue, which can never be confounded with the blue colour of flax.

(*b.*) *Fibres viewed longitudinally.*—Parcels of closely-packed fibre, very difficult to separate with a needle, of a yellow more or less deep, when the jute is raw or imperfectly bleached. Central duct very apparent, filled with elongated air-bubbles; irregularly-shaped edges, forming marked projections and sinuosities, especially towards the extremities. Walls of unequal thickness. Fibres very short—·06 or ·09 in., seldom attaining a length of ·15 in.

(*c.*) Points of the fibres almost always terminate in fantastic shapes, sinuous, dentate, and the like. No other vegetable filaments present this characteristic.

Cotton.—(*a.*) *Transverse Sections.*—Never present themselves in clusters, but always isolated; sometimes rounded in outline, but most often kidney-shaped, and taking a deep blue colour. Central cavity generally linear, elongated and convolute, as in the figure, filled with a substance that takes a brown or yellow colour.

(*b.*) *Fibres viewed longitudinally.*—Separate, twisted spirally, with a rounded, smooth, raised margin, the interior surface being plaited in various ways. Central duct supplied with patches of granular deposit, of a yellow colour, abundant in raw cotton, but disappearing after the cotton has been bleached. At various points on the exterior, adherent flakes of the same yellow substance may be observed.

(*c.*) *Points.*—One extremity of each fibre terminates in a point, blunt or rounded.

China-grass.—(*a.*) *Transverse Sections* resembling those of *flax*, but at least twice as large, without the yellow external rim; a deposit of yellow matter is frequently observable in the central cavity. The contours of the sections are tortuous, with re-entering angles, the central cavities very large, and corresponding in outline with the exterior of the section. There is no intimate contact between the figures; they are simply placed close together in groups; when the filaments have been bleached, they are separate; fine lines or fissures radiate from the inner towards the outer surface of the walls. This peculiarity is common to the Nettle tribe.

(*b.*) *Fibres viewed longitudinally.*—Separate and independent. Enormous differences in their diameters. Surfaces, violet of different shades, smooth and finely striated, often marked with numerous fine lines; many of the fibres are striated spirally; interior canal contains patches of brownish yellow granular substance; the length of the fibres various, from ·18 in. to ·36 in. *Flax* and *hemp* rarely attain to the first-named dimensions.

(*c.*) *Points* often lanceolate, but less irregular in their outlines than those of hemp; they begin to taper off gradually at some distance from their points.

Phormium tenax.—(*a.*) *Transverse Sections.*—Yellow clusters presenting a certain analogy to those of *hemp*, but without the rectilinear polygonal outlines of the latter. Angles rounded; sides convex; no intimate contact. Central cavity resembling that of *jute*, but often of smaller size. The sections are destitute of the deep yellow marginal line on the exterior.

(*b.*) *Fibres viewed longitudinally.*—Have little mutual adherence. Diameter very uniform; walls of uniform thickness. Fibres rectilinear, fine, rigid; length varies from ·15 in. to ·36 in., or double the average of those of hemp.

(*c.*) *Points* sharpening off gradually and regularly like those of flax, fine, hollow.

PRACTICAL NOTES ON ECONOMIC MANUFACTURE.

F in the good old days of cheap coal, cheap labour, and easy competition, economy of manufacture was but little studied, the manufacturer of the present day need hardly be reminded that this state of things no longer exists. We may look to the west, we may glance to the east, and with few exceptions the same current of industrial activity greets our eye. There, the mist which had shrouded the Western Continent is being rolled back; the husbandman is replying to the cry for culture of broad savannahs rich in Nature's gifts. Deep woods hitherto rotting in ignoble loneliness are now supplying various industries, whilst broad rivers, wandering loose through the marsh and supplying drink to the foul serpent, have at the present time seen the coming of him who builds their embank-

ments, and not merely renders their streams musical with the clack of the mill wheel, but also beautiful with the presence of the sail, with the presence of steam. The waves of the Pacific are now beating on the homesteads of European men in America, the shores of Australia, the harbours of New Zealand are increasing the depth, width, and volume of the vast and regularly increasing population which pours into that huge reservoir, and, as a consequence, mills are springing up over this whole continent to compete with those of the mother isle. Moreover, all Europe is in motion; industry recognizes no boundaries, no dykes; tides of people are rushing upon one another, to out-do each other both as regards cost and excellence of manufacture. To-day, the advertisement of an "Eastern Share List" draws ventures from all classes and countries, and, as a result, commercial enterprises are floated, which by their very existence place the most rigid obligations on the home producer if he wishes to compete at all satisfactorily.

Although the foregoing picture may have a gloomy aspect for the home producer, it is only a niggardly egoistic policy which could look upon it in this light. Discarding for the moment the impetus which such a state of things gives to the further improvement of our producing machinery which is a fact of far too great a value to be over estimated, the influence which this competing activity has exerted in the development of our trade, and the effects which have and are actually being produced by these movements, offer a brighter side to the question at issue. The first feature which we recognize emerges from man thus replying to the Creator's call,—"Go in and possess the land," as it was only by such a course that we could be awakened to the fact that we merely had a handful of that earth allotted to us in full. Fast as the tide is flowing, it will have to flow still faster before the capacious western and eastern hemispheres are filled. To confine ourselves to our more immediate surroundings, do not the countries situated between the Bosporus and East India offer a vast untilled field for our home manufactures. We need only recall the names of those once flourishing and enterprising countries associated with the historical names of the Assyrians, Babylonians, Mesopotamians, Phœnicians and Persians, which now, for want of means of communication, are lying in slumbering ruin. Is it not strange, too, that we actually fetch our domestic articles from the far distant antipodes, whereas these nearer countries could furnish our markets with the finest produce, and buy in their turn greater quantities of our manufactures from our own markets, than Europe is at present able to offer to the whole world?

With these cursory introductory remarks showing that our manufactures, although now subjected to an increasing home and foreign competition, have still vast enterprising fields to supply and to cultivate, provided we can keep our own in quality and cost, we begin a series of papers with the present, in which we intend to point out to the manufacturer the various directions in which his productive expenses may be lessened, thereby placing him on a surer footing of being able to compete with his compeers. With the commencement of these discussions we express the hope that they may prove of the highest interest and economic value to the manufacturers of England more especially, and undertake to confine our observations strictly to known facts, without entering in any way upon the domain of theory.

1. Transmission of Power from the Prime-Motor to Mill Machinery.

Beginning our observations with this subject, the manner mostly adopted in this country for transmitting the power from the prime-motor (engine or water-wheel, as the case may be) to the mill shafts, is by wheel gearing. It is, we may say, the "primitive way" of driving shafts, which, as such, has been handed down to us, and is to our minds the only advantage, if advantage it be, that can be urged in its favour. Of course we are well aware that after an invention has received for many years such a wide application, it will be hard to induce mill-owners to give up this way of driving their machinery, inasmuch as where capital is abundant and prejudice rife, men follow the beaten track. In cases where it may not be thought expedient to change the manner of gearing for the present, we must leave the parties interested to their own reasons, but on the other hand, in cases where new mills are being raised, or rebuilt after fires, &c. we cannot too strongly recommend the practice of "belt-driving" in the place of "wheel-gearing." We will give our reasons for advocating belt-driving under the four-fold bearings of its *advantages, application, wear and tear, and economy.*

The simplicity of belt-driving recommends itself as one of its advantages; the heavy, cumbrous and rumbling noise of gearing is dispensed with, whilst the constant greasing of wheels, which in belt-driving is not required, produces much filth and a disagreeable smell. Moreover, belts when properly encased may be rendered perfectly harmless, whereas in wheel-gearing, the breaking of a cog from any hard substance getting jammed in the wheels often causes a fearful crash, and is at all times dangerous. Owing to the simplicity of belt-driving, many believe that it cannot be *sure* or reliable, but has it ever occurred to these parties that driving by belt or band has after all to be resorted to, for example, in all cotton-spinning concerns? So thinking parties will answer us, "true, for such light work, belting suits our purpose very well, but we are confident that for transmitting the power of heavy-running machinery belt-driving becomes no longer reliable." We shall refute this argument when we consider the application of belt-strapping, and show from the belts working at the present day what enormous powers are actually transmitted by the use of belts. Again if a gearing wheel breaks, what a loss of time is involved! perhaps another suitable wheel is not on the place and a fresh one has to be ordered, which delay becomes even more serious and prolonged in cases where the break-down occurs in a rural neighbourhood or far distant; such a delay could never occur with belt-driving, for in the worst of cases where spare belting could not be found, the broken belt might be pieced up again, and the damage repaired, either permanently or temporarily, in less than an hour.

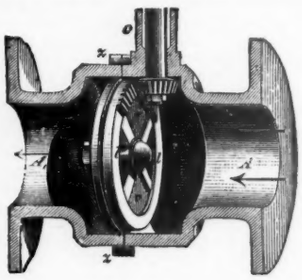
Perhaps one of the chief reasons why belting has not been so extensively adopted in this country as it is in America, is owing to the fact that comparatively few people understand the proper application of belting, and that in most instances the mill promoters leave this subject to the judgment of their mill-wrights, who as a rule push their stores of beautiful wheel-patterns and *cheap* metal to their best advantage. All authorities are of the unanimous opinion that belting to be properly applied must run at a very high speed, and be sufficiently wide to turn the machines to be put in motion, when running quite slack. This latter condition is rendered all the more necessary, since, when belts are running tight, in order to perform their work, there is a detrimental downward strain unnecessarily thrown on the upper shafting, whilst the pedestals of the driven machine are pulled upwards, so wearing out the steps, and stretching themselves to pieces, besides absorbing power.

A main driving-belt, if properly applied, should go through 3,000 to 4,000 feet, some recommend four to five thousand feet of space per minute, and the working strain of a belt should not be more than one-fourteenth of its breaking strain, since, wherever this is exceeded it becomes ultimately a disadvantage to the user. Again, the speeds of engines and the diameter of the fly-wheel should be so adapted to each other that the rim of the latter will give off a speed from 3,000 to 5,000 ft. per minute, for the power of a belt is exactly as the speed or space it runs through per minute. We further recommend large drums, not too near each other, as it is always a disadvantage to have a strap too short.

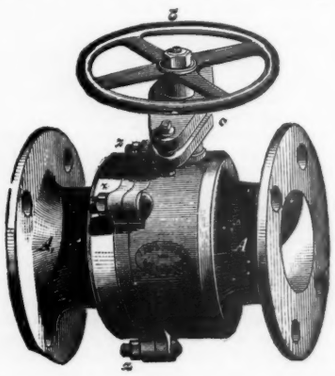
As examples of practical applications of belt-driving, which will surely upset the notion of those who do not believe that belting can be relied upon, we may mention the following: One of the most modern mills of America is driven by a pair of horizontal direct-acting engines on the Corliss principle, making fifty-one strokes per minute. In place of the fly-wheel, a drum broad enough to accommodate four belts of sufficient width to take off the power, and built up in segments of 27 ft. diameter, gives a main belt speed of 4,288 ft. per minute. A well-known manufacturer writes on his return from a tour in the United States. "In every mill I visited, I saw nothing but driving by strap instead of gearing, and in Washington mill, where they employ three thousand hands, they had turned out gearing and put in a large strap, saving, they assured me, twenty-five per cent. of power." As English examples of belt-driving we may cite the Park Mill of Bolton, where a 30 in. double belt was working very satisfactorily towards the end of last year (at the time of our noticing it), where it had been applied in the month of January preceding. This belt is working 350 horse-power direct from the engine, running through only 2,500 ft. of space per minute. Although we consider this speed too little for the power transmitted by it, the belt-driving arrangement has given such satisfaction to this spinning company, that they were arranging to drive their new mill by belting also. One of the largest belts in England is working at the Finsley Mill, Burnley, where it is transmitting 300 indicated horse-power through a 36 inch wide double belt; 200 horse-power are there also thrown off by a 24 in. wide belt. Both belts were travelling through 4,300 ft. per minute, and here they also prefer the belting system to gearing. In short, a great number of firms might be referred to, who are turning from 50 to 300 horse power by belts from 8 in. to 24 in. 30 in. and 36 in. wide; in fact, 350 horse power can be readily obtained from a 36 in. belt, provided the pulleys are large enough, and the speed of the engine correct—thus proving that heavy gearing can be entirely dispensed with.

NEW VALVE FOR GAS, WATER, AND STEAM PIPES.

WE are indebted to "Stummer's Ingenieur" for the annexed representation of a new valve for gas, water, and steam pipes, invented and patented by an Austrian engineer, M. Munck, of Vienna. The valve-chamber is formed in two parts A and A_1, united by a screw-joint at *z z*. The discs are two in number, one fixed in the half A_1; the other, mounted on the



same axis, and movable at will by means of the toothed wheel and handle *c*. The figures show the valve open. By turning the handle the portions *v v* of the movable disc can be adjusted in any required degree to the apertures *l l* in the fixed disc, so



as to regulate the flow of the gas or water as desired. These valves are manufactured by M. Munck in gun-metal wholly, or with cast-iron valve-chambers and wheels, and of all sizes, at prices ranging from twenty shillings, upwards, according to size.

Engineering, Building, &c.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, &c.

§ 1. *Engineering.*

MOUNTAIN Railways.—A committee of engineers lately consulted by the Swiss Federal Government, lay down the following general principles as applicable to the construction of railways in the Alps and all other mountainous districts :—

1. Gradients not exceeding $\frac{7}{100}$ may be worked with locomotives.
2. Steeper gradients must be reduced by lengthening the lines.
3. A level run in should be formed at foot of every descent.
4. Care is especially requisite during the descent of trains, which is the dangerous portion of the journey.
5. A locomotive should never be allowed to bring down more cars than it takes up.
6. In addition to ordinary brakes, each train should have a continuous compressed-air brake, and special means of cutting off the steam.
7. The cars should all be provided with powerful self-acting brakes in case the train should acquire undue velocity in the descent.
8. The locomotives should be provided with sandboxes to increase the hold of the wheels on the rails.
9. All complex arrangements, such as the use of two-storied cars and the like, should be avoided. *Revue Indust. 3rd March*, 1875.

Production of Railway Rolling-Stock in Prussia.—In the year 1873 there were constructed in Prussia 563 locomotives, 684 passenger carriages, and 7,456 goods trucks. In the first nine months of 1874, the number of each manufactured was 787 locomotives, 1,150 passenger carriages, and 12,605 goods trucks. The number of each in hand during the last three months of the same year was 309 locomotives, 343 passenger carriages, and 3,129 goods trucks. The orders received during the current year, up to the time the note was written, included 453 locomotives, 186 passenger carriages, and 2,171 goods trucks. The total number of locomotives, carriages, and trucks manufactured or in hand between 1st January, 1874, and the date of the note (not given) amounts to 1,549 locomotives, 1,670 passenger carriages, and 17,005 goods trucks, representing a total value of 53,753,340 thalers (about £8,000,000 sterling).

To this number must be added 892 locomotives, 1,133 passenger carriages, and 12,072 goods trucks in use on the State railways, which may be taken to represent a further sum of 33,192,700 thalers (about four and a-half millions sterling). With the exception of thirty locomotives ordered from abroad to save time, all the above were built by German, and the greater number by Prussian, makers. *Moniteur Indust. Belge, 20th March*, 1875, *from Berg-Geist.*

Wyss and Studer's Hydraulic Motor. — This apparatus much resembles the portable water motor invented by M. SCHMID of Zürich, and noticed in the "Practical Magazine" for March, 1875, as well suited for driving sewing machines and such little purposes. M. BURKLI-ZEIGLER, the well-known Swiss engineer, reports upon it very favourably, as securing an equable pressure of the water on the trunnions, a minimum of friction, absence of noise, and a maximum of useful effect. The motor consists of a piston working in a cylinder oscillating on trunnions, the distribution of the water being effected by the oscillating movement. The diameter of the piston in M. Burkli-Zeigler's experiments was $0^m.088$; that of the piston-rod, $0^m.171$; and the length of stroke, $0^m.0255$. The number of revolutions per second varied from 0·6 to 2·4. The most advantageous speed was found to be from 1 to 2 revolutions per second, or 60 to 120 per minute. The useful effect is estimated at 90·2 per cent. The manufacture of the apparatus in France has been entrusted to M. Sayn, 170, Avenue Philippe-Auguste, Paris, where it may be seen at work. *Revue Indust. 7th April*, 1875.

Steam Hill Climber.—A new locomotive, for use on Ithaca Hill, New York, has made its appearance. The incline has five tracks, of which the two outer are of the usual width, and used in the ordinary manner. When the engine starts up the hill, it runs upon a pair of rails just within the usual track, and upon a set of double-flanged small driving wheels, which are upon the same axles as the big drivers—they being only about 30 in. in diameter; this inside track is raised 15 to 18 in. above the outer one, and high enough so that the big drivers do not touch the track at all; the engine now rests upon the small drivers, and is independent of the outer ones; then in the centre of the track is placed a wide cogged rail, which exactly meshes into a cog wheel placed between the two small drivers, under the centre of the locomotive. By applying power to the big drivers, in the ordinary way, the power is carried to the cogged wheel, which does the climbing. The cogs are 3 in. from tip to tip, and the wheel is 8 in. wide. *Scientific American, 3rd April*, 1875.

New Hill Locomotive.—WACKER, organ-builder, Basle, has invented a locomotive with wheels running on two parallel rails in the ordinary way, but furnished also with a couple of horizontal rollers working against a central rail laid midway between the other two. German railway engineers report favourably upon it, as being well adapted for working inclines, and simpler and safer in principle than the projects involving the use of cogged wheels. *Neue Deutsche Gewerbe-Zeitung, No. 7*, 1875.

Improved Coal Trucks.—HERDER, inspector of rolling-stock on the Winkeln-Herisau line, has constructed caissons for the conveyance of coal and heavy goods, which obviate the delays ordinarily attendant on a break of gauge. The caissons can be loaded at the pit's mouth and carried on narrow-gauge trollies as far as required; when a break of guage occurs, four caissons can be packed on each wide-gauge platform car, without unloading. *Neue Deutsche Gewerbe-Zeitung, No.* 7, 1875.

Hair Driving Bands for Machinery.—In the "Practical Magazine" for December, 1874, p. 400, Dr. Springmühl, of Leipzig, noticed the increased employment in Germany of hair (presumably alpaca) bands for driving machinery. The undermentioned journal gives the following results of a trial of the hair bands manufactured by Benecke, of 59, Admiralstrasse, Hamburg, against ordinary leather bands. The experiments were made at the Brunswick Maschinen-Anstalt, at Brunswick.

Description of Band.	Elongation. Weight.	Elongation. Length.	Breaking Weight.
Leather bands.	kilogs.	millm.	kilogs.
No. 1. 52 mm. broad.	455	13	455
No. 2. 78 mm. broad.	535	23	575
No. 3. 98 mm. broad.	725	23	835
Hair bands.			
No. 1. 52 mm. broad.	775	29	855
No. 2. 78 mm. broad.	1085	23	1120
No. 3. 98 mm. broad.	1305	29	1320

The hair bands have therefore double the strength of the ordinary leather bands of equal dimensions; besides which, they are much less susceptible to the influences of heat and damp. *Stummer's Ingenieur, 2nd April,* 1875.

New Tramway Cars.—The Compagnie Belge pour la Construction de Machines, &c., de Chemins de fer patents a new design of a tramway car with two separate bodies connected by a platform. The forebody seats eight first-class passengers, the hind-body, a like number of second-class passengers, and the platform between accommodates fourteen more passengers in a standing position. A place for the driver is provided at each end, as on ordinary cars. All the details have been very carefully studied.

The *Société Métallurgique Belge* has just completed a very spacious new pattern tramway car at its works at Nivelles. The car is intended for the tramway at Lille. Various improvements have been introduced in the mode of suspension and in the wheels; the usual small windows are replaced by others of plate-glass of large dimensions; and the steps are placed in the axis of the car, so that passengers are not obliged to step off sideways as in the old-pattern cars. *Revue Indust. 10th March,* 1875.

§ 2. *Building, Decoration, &c.*

Sand and its Effects in Mortar.—We are indebted to the undermentioned journal for the following useful epitome of information compiled from various French sources:—

"Sand is designated as coarse, middling, fine, and very fine. It is considered coarse when the grains have a diameter of 2 to 3 millimetres; that is to say, $\frac{1}{12}$ in. to $\frac{1}{8}$ in; and it is called fine when the grains do not exceed one millimetre ($\frac{1}{25}$ in.) That which exceeds the former diameter is called gravel.

Besides river and sea sand, we have those which are found away from water sources, known as fossil sands, of the plain, or quarry sand; but these must be distinguished from the true fossil sands, which are called *arènes* in France. Fossil sand is far more irregular in the grain than either river or sea sand; it is far more gritty when the grains are strongly compressed between the fingers; quartz and granite dominate in its composition. Near the sea are found large dunes or hills of shifting sand; the most extensive of these deposits is near Dunkirk, in France. In the districts near the coast there are also extensive plains, in which the sand is mixed with various proportions of the earth, and which form sterile wastes further along the sea-coast of Belgium, Holland, and Northern Germany. In the composition of mortar, sand forms the inert matter; it exercises no chemical action on the lime, the puzzolanic constituents, and the mortars with which it is mixed; its action is purely mechanical, and consists in the aggregation of the grains by the aid of the lime and cements, which perform the part of mordants, or active agents of cohesion; it follows that the sand of which the grains are the most angular and the angles the sharpest, are preferable to those with rounded grains, or of which the asperities are less numerous. The various kinds of sands should be harsh to the touch, gritty to the fingers, exempt from earthy matter, which causes disaggregation of the mortar by humidity; and for the same reason, though to a less degree, marly or clayey sand should be rejected.

In the case of sea sand, the first thing to be done is to get rid of the salt. The presence of salt, however, may be very useful in certain cases. It is of great importance to take careful note of the various results obtained by the use of different kinds of sand found where works are being carried on; some kinds contribute powerfully to the cohesion of mortars, in combination with certain kinds of lime, while others are the cause of disintegration. Experiments of this kind cannot be too numerous or too carefully conducted. M. Vicat instituted a series of experiments in order to determine the effect of the coarseness or fineness of eminently siliceous sands on the resistance of mortars, and arrived at the conclusion that for use with eminently hydraulic lime, sand ranks as follows:—1, fine grain; 2, sand with mixed grain and sharp angles; 3, coarse sand; while in the case of moderately hydraulic lime, the order is reversed, the coarse standing first, the mixed second, and the fine grain last. Results since obtained with other kinds of sand have fully borne out M. Vicat's conclusions. The mixture of lime and sand is the more complete, and the aggregation the more intimate, in proportion to the roughness of the grains; river sand, which has been extracted and left on the banks for many months, having its surfaces corroded by natural agents, is beyond all question the best; but those of the quarries, which are best when their composition is very siliceous, offer much the same advantages in practice. Mortar made from quick-lime and coarse sand is the most durable; fine sand acts best with hydraulic limes. In the case of hydraulic mortars, the definite setting with middling-sized sand being fixed at 100, the proportion will descend as low as fifty with gravel, and even lower when it is very coarse.

Quartzose and siliceous sands are insensible to the most powerful compression. This quality has caused them to be sought for paving-work; and they are preferred before all others for foundations, and in all cases where great pressure has to be considered. According to M. Beaudemoulin, if a quantity of dry sand be placed in a box of thin sheet iron, or even in a canvass bag, and subjected to a slight compression, it forms a mass capable of resisting a pressure of fully sixty tons without breaking or even straining the envelope. The sand, however, remains perfectly divisible, so that if a small hole be made in the box or bag it will flow slowly, and with so little force that even a small piece of paper pasted over the opening will check the flow, even with the sixty tons weight upon it. M. Beaudemoulin thinks this discovery of his may be utilized for building purposes, since the filled boxes need merely be held in place by a framework; while, being very thick, they would form a protection, in case of being used for dwellings, against variations of temperature. Such walls, besides, would be fire-proof. It is also suggested that for lowering heavy weights, or even entire buildings, which, by a change of street levels, have been left too high above the roadway, the sand bags could be placed beneath, and their contents allowed gradually to escape, thus letting the load slowly settle down." *Journal of Applied Science, April,* 1875.

Self-acting Painting Machine.—W. ROBERTS, of Bootle, near Liverpool, has patented an invention for painting the laths of Venetian blinds, hoop-iron, &c. It is stated to be so simple that it is almost impossible for it to get out of order; to be able to paint 600 blind laths of ordinary size, or 5 tons of hoop-iron, within the hour; and its execution is said to be equal to the best hand-work. One of these machines may be seen daily in operation at the window-blind manufactory of Mr. H. W. Green, Kilburn Road Works, London, N.W.

House-Rot.—In an interesting paper on "House-Rot" (dry and wet rot), M. PUDIL, Clerk of Works to Prince Lobkovic, at Bilin, states as the result of many years' personal observation, that the rot is always more prevalent on gneiss and granitic sites, and where the soil and building materials are derived from gneiss, granite, or such like rocks, which contain a large proportion of felspar. Not only does the alkali appear to afford nutriment to the fungi, but these stones and the soils derived from them are highly hygroscopic, and occasion a certain dampness in the surroundings, which favours the development of these growths. Dr. Leube, sen., has shown that 100 parts of the said fungi, dried at a temperature of 100° C., gave on analysis: 30·55 parts of carbonic acid, 4·06 hydrogen, 29·92 oxygen, 2·46 nitrogen, 32·98 ash; the ash containing potash, soda, magnesia, lime, clay, iron, manganese, chlorine, sulphuric acid, carbonic acid, and silicic acid. Sound timber of the same description as that from which the fungi were taken, gave 1 per cent. of ash only. (See "Prize Essay," pub-

lished in "Mittheilungen d. Sächsisch. Ing.-Verein," 1866.) The enormously increased proportion of ash shows how largely the fungus draws upon the surrounding masonry for nutriment. *Neue Deutsche Gewerbe-Zeitung, No.* 2, 1875.

Cure for badly-shutting Windows.—M. SCHÜTZE communicates the following to the Dresden Gewerbe-Verein, as an infallible cure for badly-closing windows. Cover the bottom of the sash with fresh putty; chalk the corresponding face of the frame; shut down the window fast; and leave it long enough for the putty to harden. The fresh putty will accommodate itself to any inequalities, and harden into a permanent close-fitting joint, any excess being pressed out between the sash and the frame. The chalk on the latter will prevent the putty adhering to it and so interfering with the reopening of the window. *Stummer's Ingenieur, 26th March*, 1875.

Useful Cements.—1. *Waterproof Cement for Cast-Iron Pipes*, &c. Take equal weights, in dry powder, of burnt lime, Roman cement, pipeclay and loam, and knead the whole with about one-sixth of its weight of linseed oil. An increased proportion of Roman cement improves the quality.

2. *Cement which resists moisture and heat, but not the direct application of fire suitable for gas and steampipes*, &c. Take 6 parts red lead, 2 parts white lead, and 4 parts pipeclay; fine and dry, and mix into a stiff mass with boiled linseed oil.

3. *Rust Cement for Water and Steam-pipes, Steam Boilers*, &c. Make a stiff paste by mixing 2 parts sal-ammoniac, 35 parts iron borings, 1 part sulphur, with water, and drive it into the joint with a chisel.

Or, take two parts sal-ammoniac, 1 part flowers of sulphur, 60 parts of iron chips, and mix with water containing a sixth part of vinegar or a little sulphuric acid.

Or, mix 100 parts bright iron filings, or fine chips or borings, with 1 part powdered sal-ammoniac, moistening with urine. When prepared, force it into the joints. It will prove serviceable under the action of fire.

4. *Cement for the Joints of Iron Stoves.* Equal quantities mixed, sifted road ashes, and finely-powdered clay with a little salt. When required for use, add water enough to make a thick paste.

5. *Iron Cement, unaffected by a Red Heat.* Take 4 parts iron filings, 2 parts clay, 1 part firebrick; reduce to the size of rape-seed, and mix into a thick paste with a saturated solution of salt.

6. *Cement for fastening Wood to Stone.* Melt together: 4 parts pitch, 1 part wax, and add 4 parts pounded brick-dust or chalk. Must be warmed before use, and applied thinly to the surfaces to be joined. *Des Ingenieurs Taschenbuch.*

Copying-Machine for Statuaries, Wood-Carvers, &c.—BRIX, statuary, of Copenhagen, patents an improved form of copying-machine for the use of the above. The machine is not described, but is stated to be simple in construction, easily used, and very accurate, reproducing faithfully the minutest details of the original to any desired scale. *Industri-Tidende (Copenhagen), 28th Feb.* 1875.

Roof-top Garden-houses.—The "Gardener's Magazine" calls attention to the horticultural capabilities of house-tops in our large towns, where room is scarce, and instances, as a late example of a roof-top conservatory, that recently erected by Messrs. Fletcher and Co., of Westminster, on Messrs. Barr and Sugden's new premises, 12, King Street, Covent Garden. It is a light, cheerful, airy, elegant structure, built entirely of iron and glass; the curvilinear outline of which is obtained without the use of bent glass. The glass used is ground glass, which was thought desirable to modify the strong glare of the summer sunshine. The weight of a superstructure of this description is so slight as to necessitate no special precautions. It need not be devoted to plants, although nine times out of ten that would be the best use for it; the abundance of light and air, and the genial temperature, would render it suitable for many other purposes besides. As it has been said, and with truth, that defect of solar light is one great cause of the debilitating effect of town life on health, it is at least one argument in favour of a house-top garden that it catches all the solar light the murky sky can give in the midst of the houses.

Cement for Petroleum Cisterns.—A useful cement, which hardens very quickly, is formed of litharge mixed with glycerine. It may be used for water and steam-pipes, as well as for lining cisterns for petroleum oils. *Revue Indust. March* 31, 1875.

Papier-Maché for Panelling, Veneering, &c.—The undermentioned journal notices some beautiful specimens of papier-mâché panelling, in imitation of oak, mahogany, and other woods, prepared by a process, patented in Denmark, by Œerling and C. Hansen, of Ebeltoft. They are stated to be undistinguishable from choice specimens of the woods in question, and superior to them in point of strength, as compared with weight and power of withstanding damp. Further particulars are promised. *Industri-Tidende (Copenhagen), 4th April*, 1875.

EXTINGUISHING FIRES ON SHIPBOARD.

LIEUTENANT F. M. BARBER, U.S.N., in a letter to the "Scientific American," writes as follows:—

In view of the inefficiency of the methods at present in use for extinguishing fires on board ship, and particularly in sailing vessels, I propose to make use of carbonic acid gas in a manner which, I believe, has not hitherto been proposed. The plan is to have, in some convenient locality, a flask or flasks, each about 3 ft. in length and 1 ft. in diameter, containing about 100 lbs. of the gas in a liquid state. From the top or upper side of the flask, a small iron pipe is to be permanently fitted along the water ways (or just under the deck), throughout the entire length of the ship. From this main pipe, at suitable intervals, are branch pipes, at right angles to the main, passing down next the skin, to every store-room and hold of the ship; so that each compartment of the vessel shall have its own pipe, or pipes, reaching from its bottom to the main pipe at the spar deck. There is to be a cock in the main pipe near the gas flask, and one in each branch pipe near the main, any one of which can be turned from the spar deck.

On the alarm of fire, the hatches are to be battened down; the cock in the branch pipe leading to the compartment where the fire is discovered is to be opened, and also the cock in the main next the gas flask. The liquid gas, which is under a heavy pressure in the flask, passes out through the pipe in the form of vapour, as soon as the pressure is relieved by turning the main cock, and is driven in an instant, by the great pressure behind it, to the compartment to which it is admitted. Arrived at this point, and being 1½ times as heavy as air, it fills the compartment from the bottom up, without being diluted with the air, and producing intense cold by its expansion at the same time; while the pressure with which it enters forces it into all interstices in the cargo, driving out every particle of air, which will all escape from the top, as no compartment on board ship is absolutely air-tight. Knowing, then, the cubic contents of any compartment, and the cubic space occupied by the cargo in it, sufficient gas can be admitted to render it absolutely certain that no fire can exist there, without the necessity of opening the hatches to see if the fire is out, until such time shall have elapsed as to render it perfectly safe to do so. By shutting the cock in the main pipe, the remainder of the gas is kept from vaporizing, until such time as it may be required. On arriving in port, the flask is disconnected from its pipe, and can be refilled in a couple of hours, and then set up and connected in its usual place.

Should no fire occur, the apparatus can remain intact for an indefinite time, except occasionally to see that the cocks are in working order. The liquid is entirely non-corrosive in its character, and the vapour is not injurious to any class of cargo, while it is, I think, the only substance that will permanently suppress the most advanced state of combustion in a cargo of coal.

It is, of course, well known that carbonic acid gas is the agent employed in the Babcock extinguisher, and others of like nature; but in these the gas is produced on the spot by the action of an acid on marble dust or bicarbonate of soda. The objections to such an arrangement are that the apparatus is somewhat cumbersome and complicated, and the supply of gas is rather limited, unless a great number of machines are used. Moreover it must all be expended when once generated; and before a fresh supply can be obtained from any one machine, the apparatus must be cleaned out, and the requisite materials re-arranged; while in consequence of the moderate and varying pressure of the gas produced, a permanent system of pipes cannot be employed to carry the gas to any great distance from the generator. What I propose is simply to carry on board ship the gas itself in its most condensed form, the liquid, of which 1 lb. is equal to a trifle over 8 cubic ft. of pure gas, to be contained in vessels capable of withstanding the great pressure necessary to keep it from vaporizing at any temperature.

ENGLISH TRADE IN 1874.

BASING their comparison on the Board of Trade returns for the past year, the commercial German press has just produced some interesting comparisons on the conditions of English trade during 1874. Moreover, these calculations have been so well received on the Continent that the technical journals in Germany have reproduced these trade statistics. The interest which is thus manifested on this question is our reason for bringing this commercial inquiry to the notice of the English public.

We are, firstly, reminded that our imports, as well as our exports, have decreased, if we take their commercial value into account; for the imports in 1873 reached the sum of £371,287,000, whereas in 1874 the corresponding value was £368,435,000. This decrease in the imports is naturally attributed to the good English harvest, which consequently rendered England the more independent of foreign supply. The export trade of English products has decreased in a more rapid manner, having fallen from £255,164,000 to £239,436,000. The re-exportation of imported foreign and colonial articles has been somewhat increased, ranging from £55,830,000 to about £56,500,000, thus shewing an approximate total export trade of £295,894,000, or a decrease of £15,101,000 on 1873, which is at the rate of 5 per cent. Taking the imports and exports together, we find that English commerce has sunk from £682,282,000 to £664,330,000, showing a decrease in 1874 of £17,952,000, that is at the approximate rate of 2½ per cent. on 1873.

Reviewing the various products separately, we shall find that amongst the imports, seventy-one articles have increased in quantity against fifty-nine decreasing, and that further, with regard to value, sixty-eight articles have increased against sixty-five decreasing in value. From this we may conclude that the fluctuations of value and quantity have been to all intents identical in relation to each other. Amongst our exports of seventy-one articles, thirty-eight have increased, and the remainder have decreased in quantity; whereas, with regard to their value, thirty-four have augmented and thirty-seven articles have diminished. Of these seventy-one articles, only three have decreased in quantity and increased in value, namely, beer, mixed cotton materials, and steel goods; on the other hand, seven articles have decreased in quantity as well as in value.

Of all the English export articles, coal represents best the relative positions of England and the Continent. The coal exports rose from 12,618,000 to 13,909,000 tons, but sank in value from £13,189,000 in 1873 to £11,954,000 in 1874. France, which stands most in need of foreign coal supply, has imported somewhat less English coal in 1874 than in 1873; the same remark applies to Holland, Denmark, Spain, and Brazil, but the English supply of coal has increased with all other countries, Germany ranking with 600,000 tons, whereas Russia imported 882,000 tons against 612,000 tons in the preceding year (1873).

The iron trade is best shown by the following table:—

	Metal Exports per Quantities.				Metal Exports per Values.			
	1873.	1874.	1874. Increase or Decrease.		1873.	1874.	1874. Increase or Decrease.	
	Tons.	*Tons.*	*Tons.*	*Percentage.*	£	£	£	*Percentage.*
Iron—unwrought	1,142,000	774,000	— 368,000	— 32	7,118,000	3,699,000	— 3,419,000	— 48
„ bar	287,000	260,000	— 27,000	— 9	3,756,000	3,062,000	— 649,000	— 18·5
Rails	785,000	782,000	— 3,000	— 0·4	10,419,000	9,630,000	— 789,000	— 7·6
Wire	29,000	37,000	+ 8,000	+ 27·6	693,000	771,000	+ 78,000	+ 11·3
Hoop and sheet iron	202,000	169,000	— 33,000	— 16·3	3,723,000	2,977,000	— 746,000	— 20
Rolled and cast iron and steel	282,000	258,000	— 24,000	— 8·5	5,479,000	5,132,000	— 347,000	— 6·3
Tinned plate	121,000	123,000	+ 2,000	+ 1·7	3,953,000	3,716,000	— 237,000	— 6·0
Iron not rolled	39,000	31,000	— 8,000	— 20·5	1,463,000	1,205,000	— 258,000	— 7·1
Steel and iron manufacture	10,500	10,000	— 500	— 4·8	729,000	790,000	+ 61,000	+ 8·4

From this table we perceive that the only really large decrease in the English iron export trade, both with regard to quantity and value, takes place with unwrought iron, depending on coals. In spite of the diminution in price of this kind of iron, the prices are still found too high, for, like coals, the quotations still maintained the rates of 1872, being thus much higher than the prices of 1870 and 1871; hence the comparatively small continental demand for this kind of iron.

A less prominent decline is noticeable in the other kinds of iron. Taking the actual German demand for quantity during the past year, we find the following comparision on the year 1873:—

	Iron exports to Germany: in tons.		Decline in these exports.
	1873.	1874.	Per cent.
Iron, unwrought	261,000	177,000	32
„ bar	27,000	8,000	9
Rails	40,000	7,000	0·4
Iron hoops, sheets	26,000	11,000	11
Iron and steel rolled	28,000	14,000	8·5
	382,000	217,000	43

The other metal exports show still less unsatisfactory results, if we except crude copper, which sank from 259,000 to 215,000 cwt., corresponding to a fall of 17 per cent., with a reduced value of £4·7 to £4·4 per cent.

To enumerate a further export article, cotton has been selected by the German press. An average reduction from £0·074 to £0·066 has been experienced with cotton yarns, with a comparatively slight increase in the quantity exported, corresponding from 215,000,000 lbs. in 1873 to 221,000,000 lbs. in 1874 (showing an increase at the rate of 3 per cent.), but representing a decrease in value from £15,895,000 to £14,516,000, which is at the rate of 8 per cent. Germany's demand remained at the figure of 37,000,000 lbs. weight. Plain cotton goods, retaining their average price, increased somewhat in quantity, from 2,384,000,000 to 2,584,000,000 yards, which gives an increase at the rate of 9 per cent. on the year 1873.

Printed cotton goods sank from 1,083,000,000 to 1,003,000,000 yards = — 8 per cent., and stocking goods from 1,127,000 to 1,021,000 pairs = — 9 per cent. Cotton mixed materials show no appreciable change on 1873. On the other hand, a slight increase is perceptible in sewing cotton, as may be seen from the following statement, representing the value of our total exports in the cotton manufactures.

	1873.	1874.	Increase. Per cent.	Decline. Per cent.
Cotton yarns	£15,895,000	14,516,000		— 9
Cotton goods—				
Plain	34,283,000	34,735,000	+ 10	
Printed	21,581,000	19,600,000		— 9
Mixed materials	629,000	687,000	+ 9	
Stockings	417,000	361,000		— 13
Sewing cotton	1,469,000	1,590,000	+ 8	
Total	£74,274,000	£71,489,000		— 4

Amongst further woven goods, of which the total exports attain only half the magnitude of the cotton trade, we find the following enumerated:—

	1873.	1874.	Increase. Decline. Per cent.
Woollen goods	£14,278,000	£11,887,000	— 17
Linen „	7,306,000	7,124,000	— 3
Jute „	1,591,000	1,668,000	+ 5
Silk manufactures	331,000	458,000	+ 38
Cotton goods	58,379,000	56,973,000	— 2
Total of these manufactures	£81,885,000	£78,110,000	— 4·5

which thus represents a decrease in value exported during 1874 of 4·5 per cent., when compared with the corresponding value of 1873.

The conclusion drawn from this summary is that the same doleful picture presents itself in almost all branches of English commerce, when the excess of production is considered, above

the home demand. We are also reminded, that trivial as this decline of export commerce may appear to many, still this state of trade is most unsatisfactory, when we recollect that a decrease of annual English commerce is of rare occurrence. If we are to be guided by past experience, we shall find that declines of English commerce have been effected by excessive speculations The last decline of British trade happened in 1867. At this period, the value of British commerce amounted to £500,986,000, comparing with £534,196,000 in 1866, thus showing a decline at the rate of 6 per cent. The preceding decline of trade worthy of notice happened on the year of 1858, on 1857, in which a decrease took place from £334,019,000 to £304,367,000, or nearly at a rate of 9 per cent. These figures show, fortunately, that hitherto these declining percentage rates have been steadily diminished; for

In 1858, the rate of decline was 9 per cent.
„ 1867 „ „ 6 „
„ 1874 „ „ 2½ „

But whether the same diminishing ratio will also hold good for the future slack commerce periods, it is, of course, impossible for us to predict.

COTTON INDUSTRY OF ENGLAND (*compiled from* 1865 *to* 1874 *inclusive*).

	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.
Cotton consumed	*718,651	890,721	954,517	996,197	939,019	1,071,770	1,205,450	1,175,345	1,246,150	1,266,129
Deducting waste in spinning	100,611	115,793	114,533	119,544	122,070	129,310	132,600	134,965	168,230	145,604
Production of cotton yarn	618,040	774,928	839,984	876,635	816,949	942,460	1,072,850	1,040,380	1,077,920	1,120,525
Export of cotton yarn	98,563	134,835	164,276	174,538	164,518	186,078	193,480	211,940	214,687	220,599
Export of woven fabrics	377,357	490,607	253,582	548,628	535,195	616,232	679,520	698,840	688,233	726,000
Home consumption and stock	142,120	149,486	152,126	153,487	112,236	140,150	199,850	129,600	175,000	173,926
Total	618,040	774,928	839,984	876,653	816,949	942,460	1,072,850	1,040,380	1,077,920	1,120,525

	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.
Declared value of yarn exports	†10,351	13,700	13,690	14,709	14,157	14,671	15,055	16,710	15,876	14,516
Declared value of woven cotton fabrics	50,105	66,386	57,382	57,343	57,660	61,424	63,382	69,900	68,136	65,934
Estimated value of the home consumption	21,910	23,035	19,363	19,665	14,380	17,050	23,520	15,660	20,600	20,110
Value of total productions	83,266	103,121	90,435	91,717	86,197	93,145	101,957	102,270	104,612	100,560
Value of raw cotton consumed	47,257	51,958	41,272	40,989	43,772	42,145	40,810	48,054	45,441	40,226
Margin for wages, coals, machinery, printing materials, interest, &c., and profits	36,000	51,163	49,163	50,728	42,425	51,000	61,147	54,216	59,171	60,334

* Given in thousand pounds weight. † Value given in thousand pounds sterling.

Chemistry applied to the Arts, Manufactures, &c.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

§ 1. *Acids, Alkalies, and Salts.*

CONCENTRATION of Sulphuric Acid in Leaden Chambers.—Referring to his method of concentrating sulphuric acid in leaden chambers, described in "Chronique de l'Industrie," July 3, 1872, M. DE HEMPTINNE states that, since the month of August, 1873, he has In this way obtained a regular supply of excellent acid, of 66° Baumé, limpid and nearly colourless. He feels no hesitation in asserting that the costly platinum retorts now used for the purpose may be dispensed with altogether. This acid is concentrated in a leaden retort, enclosed in a cast-iron boiler, to which the heat is applied. A vacuum (72 or 73 centim. of mercury) is produced in the retort by the condensation of steam in another cast-iron boiler, which is connected with the interior of the leaden retort, and also with the space between the retort and its cast-iron shell. The atmospheric pressure is therefore borne by the iron shell alone, and the thick leaden sides of the alembic are perfectly flexible. The apparatus, complete, is figured in the undermentioned journal. *Revue Industrielle, March* 31, 1875.

Manufacture of Salicylic Acid.—Professor KOLBE, of Leipzig University, has obtained patents for two processes for the manufacture of salicylic acid on a large scale, at a very small cost. Formerly the acid was obtained from a small North American plant, *Gaultheria procumbens*, in which it exists in the form of saliciate of methyl, and was comparatively dear. The new processes are identical in principle. Carbolic acid is placed in a glass or iron retort with an alkali or alkaline earth, and exposed to a temperature of 185° C., until all the water and some of the carbolic acid have evaporated into separate vessels. A continuous current of CO_2 is then introduced into the retort, under the influence of which salicylic acid quickly forms. The contents of the retort become a compact mass, which is washed with water, and the salicylic acid precipitated with hydrochloric acid. *Bulletin de la Soc. Chim. de Paris, xxiii.* 7, 1875.

Antiseptic Properties of Salicylic Acid and Carbolic Acid Compared.—MULLER finds that small quantities of salicylic acid suffice permanently to arrest fermentation in strong solutions of grape sugar, where equal quantities of carbolic acid produce only a temporary cessation of fermentative action or remain wholly inert. These experiments, and others on fresh liver and other substances, have led to the conclusion that salicylic acid is a more certain and powerful antiseptic than carbolic acid. The annotator attributes the results to the fact that salicylic acid is a true acid, while carbolic acid is not. *Annales des Sciences de Genève, 15th Feb.*, 1875, *from Journal für Praktische Chemie.*

§ 2. *Metallurgy.*

Detecting the Presence of Lead in Tinned Vessels.—FORDOS proposes a simple method, by which the presence of so small a proportion as 1 per cent. only of lead has been detected, and which may be used without detriment to the vessels or utensils operated upon.

A thin film of nitric acid, pure, is spread over some part of the tinned surface where the deposit of tin is thickest, by touching it lightly with a tube dipped in the acid. The latter at once attacks the tin, forming oxide of tin, and, if lead is present, nitrate of lead also. After a few minutes the vessel is warmed, to arrest further reaction and get rid of the remaining acid, and allowed to cool. Afterwards the pulverulent patch on the tin is

touched with a tube dipped in iodide of potassium. The iodide has no effect on the tin, but reacts on the nitrate of lead, forming a yellow iodide of lead, the yellow colour of which is more decided as the proportion of lead is greater. A yellowish or yellowish-grey tint is not indicative of the proportion of lead, as it is sometimes produced by the finer kinds of tin. The vessel should be cleaned very carefully before the experiment is made, to get rid of any film of grease adhering to the surface; and the latter should be touched with the acid as lightly as possible, and where the tin is thickest, so that the acid may not penetrate to the subjacent metal, which would not only needlessly injure the utensil, but also complicate the reactions of the iodide. If the vessel is tinned on both sides, the experiment should be made on the outside. M. Fordos finds that lead is very generally, although illegally, present in tinned utensils of all kinds. *Comptes rendus, lxxx.* 12, *29th March*, 1875.

Brightening Iron.—BODEN recommends the following method of brightening the surfaces of iron plates, wire, &c., as the result of numerous experiments made in the laboratory of the Industrial Museum at Munich :—

The object, whatever it may be, just as it comes from the forge, is laid for the space of one hour in dilute sulphuric acid ($\frac{1}{20}$ part acid). The action of the acid may be increased by the addition of a little carbolic acid (?). The forge scales are loosened by the action of the acid, and the object is then washed clean with water, and dried with sawdust. Next, it is held for an instant in nitrous acid, the operator of course being on his guard against the nitrous fumes, washed again carefully, dried in sawdust, and rubbed over clean. Iron goods thus treated acquire a perfectly bright, pure surface, having a white glance, without the intervention of any mechanical process of polishing. *Indust.-Blätt. 1st April*, 1875, *from Mitthl. d. Bayerische Gewerben Museums.*

Absorption of Hydrogen by Metals.—MM. TROOST and HAUTEFEUILLE find that iron, nickel, and cobalt absorb hydrogen gas directly, although it cannot positively be said that it enters into combination with them; the same thing occurs with lithium and thallium. Pyrophoric iron, nickel, and cobalt condense a larger proportion of hydrogen than the same metals in a compact form; but the hydrogen is completely disengaged before a red heat is attained, and when thus deprived of their hydrogen, these metals remain pyrophoric, showing that this property is not dependent on the condensation of hydrogen. Finely comminuted iron exhibits a peculiarity which is not observable in nickel and cobalt; it decomposes water, slowly at ordinary temperatures, very rapidly at those approaching 100° C. In this respect iron resembles manganese. *Comptes rendus, lxxx.* 12, *29th March*, 1875.

Coating Brass and Copper with Zinc.—For putting a bright deposit of zinc on brass or copper, when the galvanic battery is not brought into play, BÖTTGER has hitherto employed a concentrated solution of sal-ammoniac containing fragments of zinc, in which the object to be coated is immersed and subjected to a boiling heat for a considerable time. M. Böttger now finds that an alkaline solution of oxide of zinc is quicker and surer than the sal-ammoniac.

An excess of powdered zinc is placed in a concentrated solution of potash or caustic soda, boiling. In this the objects to be coated are immersed. After a few minutes, they come out with a brilliant coating of zinc.

For what are called Zamboni's piles, very thin strips of sheet copper coated with zinc are used, the zinc being subsequently removed with hydrochloric acid from one face of each strip. These strips constitute far more active electromotors than layers of gold-leaf or imitation silver.

Pinchbeck can be made at a temperature not exceeding 120° to 140° C. When copper thinly coated with zinc is carefully heated to the above temperature (in an oil-bath is best), the thin coating of zinc combines with the subjacent copper, forming a golden-coloured pinchbeck. As soon as the desired colour is obtained, the objects should be quickly cooled in water or other suitable fluid. *Technologiste, March*, 1875.

New White Metal.—LOGEROT patents (France) a white metal, composed as follows :—

1. Pewter, regulus, copper, silver.
2. Pewter, regulus, copper, bismuth.

Revue Indust. 10th March, 1875.

3. *Dyeing, Calico Printing, Bleaching, Tanning, and Allied Subjects.*

Action of Mordants on Damp Wool.—It is well known that washed or mordanted wools should never be kept long before they are used. They are very liable to decay, the parts exposed to the air more particularly, giving out a peculiar fetid smell. Then they are useless for dyeing, and as their strength is also greatly diminished if the decay has gone on for any time, they are equally unfit for spinning. The affected portions take the colours unevenly and become spotty.

Washed wools may be kept for twenty-four hours in summer or three or four days in winter; but those that have been mordanted should not be kept beyond a few hours, especially if the place is cold and damp, unless the fixing of the mordant necessitates a longer interval. In any case, no harm arises from leaving the wool in the bath.

The dyers of the olden time, we know, when they wanted to get a plum colour from logwood, used to leave their wools in a bath of tartar and alum with or without salt of tin, for a week or a fortnight at a stretch. So lengthened an immersion is now avoided.

If the wools must be laid by, they should be first dried as thoroughly as possible. The compounds of alumina have the property of retarding decomposition of the kind in question. Wools, which have been boiled in a solution of tartar and alumina may therefore be kept for twenty-four hours without risk. When chrome is employed, it is different, particularly if it contains acid, as free chromic acid is then formed. This acid decomposes not, like alumina, with heat alone, but even in a cold bath. There is another drawback too. Wools piled one upon another take the colour unequally, because those at the bottom contain a larger proportion of mordant. For this reason, wools mordanted with chrome are left in the bath, or taken out and placed in water; sometimes they are merely rinsed in water. Wools mordanted with chrome and alum may be left in the bath; but it is always better, if possible, to finish the dyeing out of hand. *Moniteur Indust. Belge*, 10*th March*, 1875.

Black Dye for Cottons.—Without offering any special novelty, the following method appears to commend itself to the notice of dyers. The cotton is put through six successive processes. First, it is treated with carbonate of soda, washed, and passed through a bath of campeachy wood; ten to fifteen minutes suffice for the action of the latter. It is then dried. Next, the cotton is placed in a bath of potassium dichromate for a like time; 120 gr. are sufficient per kilo. of cotton. The latter is then placed in a bath of sulphate of iron for half an hour. After washing, it is again passed through a bath containing an aqueous solution of potassium dichromate, in the proportion of 30 gr. of dichromate to each kilog. of cotton. Lastly, it is washed with soap; 68 gr. of soap being allowed to each kilo. of cotton. *Moniteur Indust. Belge*, 10*th March*, 1875, *from Teinturier Pratique.*

Aniline Inks.—BIEDT, of Brunswick, furnishes the following particulars of the composition of aniline inks, observing that alcoholic solutions of aniline colours mixed with water are objectionable as inks, as they dry too quickly, and leave the writing gritty.

Red Ink. Is prepared by mixing 1 part diamant-fuchsine dissolved in water, with 150 to 200 parts of boiling water, according to the depth of tint required. Gum arabic need only be added for very rapid and continuous writing. At one time aniline red ink had a sort of purple tint; but now diamant-fuchsine can be procured that gives a bright coral red, far superior in colour to other red inks. The cost per litre is 22 to 24 pence; the ink may therefore be sold at 6 marks per litre. Much of course depends on the quality of the fuchsine, the colouring properties of which may be tested in the following way :—A normal solution is first formed, by dissolving 1 kilo. of the very best diamant-fuchsine in 10 litres of water, and a portion of the solution is placed in a test-glass of convenient size, say 20 centimetres long and one centimetre in diameter. To ascertain the colouring power of a given sample, 1 kilo. of the latter is dissolved in half the above quantity, *i. e.* 5 litres, of water; 50 cubic metres of this solution are placed in a burette of 1 centimetre diameter, and as much water is added as the solution will admit, without causing a paler shade than that of the normal solution. If the solution thus only bear the addition of 25 cubic centimetres of water only, we have $50 + 25 = 75$ as the amount of water it will colour, *i. e.* it has only 75 per cent. of the colouring power of the normal solution. A like test may be applied to other aniline colours.

Blue Ink.—Is prepared by mixing 1 part Paris blue with 200 to 250 parts of boiling water. If the ink dries with a coppery hue, more water must be added.

Violet Ink.—Is the most used of all the aniline inks. It is sold under various fanciful appellations. Beyer of Chemnitz prepares it under the name of "Encre de la Noblesse," and Nikatowski of Berlin under that of "Furieuse et Brillante Encre de Salon Parisienne" (!). It is sold at 2·5 to 6 marks per litre, the cost

of production being at most 2 marks. It is prepared by mixing 1 part of aqueous solution of aniline violet in 300 parts of water. It is quickly affected by other blue inks prepared from logwood, alum, blue vitriol, &c.; so that if a pen be used which has previously been employed for other inks, it turns pale and gritty at once.

It has been proposed to render this ink portable by preparing strips of paper impregnated with it by a special process of manufacture, out of which the ink can be dissolved with water as required. But the invention has little to recommend it; the ink is very weak and pale, and requires filtering before use. It is thought that it would be better to carry the aniline solution in small capsules of definite capacity, similar to those used for artist's moist colours, so that it may be mixed as required.

Green Ink.—Is the showiest and at the same time the dearest of all the aniline inks. It is prepared by mixing 1 part iodine green with 100 parts of warm water. It gives a bluish green; if a yellowish shade be desired, a little picric acid must be added.

Yellow Ink.—Aniline yellow is not to be recommended for ink. A mixture of 1 part picric acid with 120 to 140 parts of water is cheaper and better. Aniline inks are not to be recommended for the copying press as they are too thin; and if prepared in a more concentrated form, dry with a rusty, metallic hue. *Industrie-Blätter, 4th March, 1875, from Dingler's Polytechnisches Journal.*

Cochineal.—J. MUELLER has extracted from the "Diccionario Estatistivo Administrativo de las Islas Canarias" some statistics relative to the acclimatization and cultivation of cochineal on the Canary Islands. Although the insect had been brought to Europe as early as 1523, no efforts were made to acclimatize them, and the cactus upon which they live, until 1825; and the results for the first ten years were rather discouraging than otherwise. While in 1832 but 120 lbs. was yielded, the yield in 1844 amounted to 90,000 lbs.; in 1849 to 390,000 lbs.; and in 1860 to 600,000 lbs. Of this last yield, 240,000 lbs. was produced upon the Island Gran Canaria alone, and since then the crop from this island has increased enormously, the yields of 1869 and 1870 amounting respectively to 3,000,000 lbs. The great increase in the production was induced by the introduction of guano (since 1852), the application of which necessitated, however, a large supply of moisture. The completion, within the last ten years, of large aqueducts and reservoirs has so furthered the cochineal production that the large amount above stated became possible. By the introduction of lac dye from the East Indies the prices of cochineal have, however, been so reduced, as to make its cultivation scarcely profitable. Since 1862, tobacco has therefore been introduced, and as the climate and soil of the Canaries have proved very favourable to the cultivation of the latter (the quality is said to be scarcely inferior to that grown upon Cuba), there is a probability that the culture of the cochineal will gradually be superseded by that of tobacco, and that in consequence the dye-stuff will again command a higher price. This is the more to be regretted as all endeavours to acclimatize the insect in the East Indies, Java, Algiers, and in various portions of Southern Europe, have signally failed, while in Honduras the culture is yearly more neglected. *Journal of Applied Science, April, 1875.*

Algerian Ochres.—The works at Temoulga, in the subdivision of Miliana, which are the private property of a resident, produce ochres of four distinct shades, all suited for pigments—yellow, red, lilac brown, and light brown. The price varies with the colour and quality from 15 to 40 francs per 100 kilogs. (7*s.* to 16*s.* per cwt.) The yellow is cheapest, the light brown most expensive.

The use of these oxides is not limited to painting on wooden surfaces, they may be applied to metal, paper, floorcloth, plaster, &c. They may also be used as mastics for the joints of steam-machinery. An interesting experiment was made at the port of Algiers, about six months since. The buoys were painted over with the new ochres, to test the permanence of the latter when exposed to continued contact with sea-water. So far, the results have been most satisfactory. It is thought likely that a new industry will thus be secured to the colony. *Moniteur Indust. Belge, 10th March, 1875.*

§ 4. *Food, Water, and Sanitary Matters.*

Absorption of Ammonia by Soils.—From experiments on the soil in the neighbourhood of the Solfatara at Pozzuoli, M. DE LUCA has arrived at the conclusion that the soil in the vicinity of the secondary fumaroles, where the temperature is 97° C. (which contains sulphur, sulphuret of iron, sulphuret of arsenic, sulphuric acid, phosphoric acid, nitric acid, silica, alumina, oxide of iron, lime, magnesia, potash, soda, and traces of manganese) absorbs ammonia from the atmosphere in the presence of moisture; that this absorption of ammonia is due to the transformation of the sulphur and arsenic in the soil by the action of the air and moisture converting the ammonia into ammoniacal salts, which under ordinary circumstances are fixed and soluble; and that, in a dry state, and in the absence of moisture, these transformations of the sulphur and arsenic do not take place, and consequently ammonia is not absorbed. These conclusions have a certain importance in an agricultural point of view, as they show that, when pulverized, certain porous substances, such as the soil of the solfatara in question, have the property, under the influence of moisture, of fixing atmospheric ammonia, and so developing a supply of nitrogenous matter, of a kind suited for direct assimilation by plants, and this is, in a slow and progressive manner, adapted to the growth of vegetation. *Comptes rendus, lxxx. 10, 8 and 15 March, 1875.*

Wine Produce of Italy.—DI SAMBUY and BOSCHIERO estimate the average amount of the wine crop of Italy at 13 hectolitres per hectare for about 2,000,000 hectares of vineyards, or 33,000,000 hectolitres (726 million gallons) in all. At 25 lire per hectolitre, this represents a sum of 825 millions of lire, or about 35 millions sterling. *L'Economista (Florence), 28th March, 1875.*

Nitrous Acid as a Disinfectant.—During the last cholera epidemic in Munich, Professor VOGEL found that a mixture of nitrous acid and sugar was a most energetic and thorough disinfectant for closets, and a perfect deodorizer. *Stummer's Ingenieur, 19th March, 1875.*

Honey Champagne.—HANSEN, of Horsens, patents under this name, a cooling, effervescent drink, described as an essential preparation of honey. Its peculiar but agreeable flavour, combined with its wholesomeness, promise to acquire for it increasing popularity as a cheap and refreshing beverage. —*Industri-Tidende (Copenhagen), 4th April, 1875.*

[In plain English, the preparation is "mead," the nectar of Valhalla, which has been well known from time immemorial in cottage-homes in Kent and other parts of England, put forward as a novelty under a more attractive name.—H. M. C.]

Superiority of Ducks' Eggs over Hens' Eggs.—The following details are given as the results of French experiments:—An ordinary hen's egg weighing 60·4 grammes was found to have 7·2 gr. of shell and skin, and 53·7 gr. of contents, the latter, therefore, forming 88·07 per cent. of the whole weight. A duck's egg, weighing 59·8 grammes, had 7·7 gr. of shell and skin, and 52·1 gr., or 87·12 per cent. of contents. Analysis of 100 grammes of the contents of hens' eggs gave 26·01 dry residue, 1·03 ash, 11·27 fatty matter in the form of sulphuret of carbon. An equal weight of the contents of ducks' eggs gave 28·89 dry residue, 1·16 ash, 15·49 fatty matter, showing that ducks' eggs contain a notably larger proportion of nutritive matter than hens' eggs.

Comparison was also made of the productive powers of an equal number of ducks and hens. From January to August three hens laid together 257 eggs; three ducks in the same time laid 402 eggs. Besides this, the ducks laid 215 more eggs in autumn, whilst the hens were off the lay. Altogether the three ducks produced 617 eggs in the year, whilst the three hens laid 257 only. *Stummer's Ingenieur, 12th March, 1875.*

Condensed Milk in Australia.—The Sydney, New South Wales, correspondent of the "Agricultural Gazette," writes that a small factory has been started there for the manufacture of condensed milk. It is described as an excellent article, selling at 1*s.* per pound, and in brisk demand in India, China, and the Islands, and amongst shippers.

Compressed Ice.—M. GIROUARD advocates a more general adoption of the practice of storing ice in winter so as to meet the increased demand for industrial and domestic purposes. It is well known that when subjected to a suitable degree of pressure ice and snow undergo a certain change, to which Faraday gave the name of *regelation*, by which they become converted into homogeneous, plastic masses, easily moulded to any desired shape.

A couple of men with a hand or screw press could easily turn out, in the course of a day, 3,000 to 3,500 brick-shaped blocks of compressed ice, each brick weighing 10 lbs. to 12 lbs. In other words, with a sufficiency of ice at hand, they could prepare a ton to a ton and a half of compressed ice daily so long as the supply lasts. Ice thus prepared could be stored with much greater economy of space than is possible with the shapeless fragments now shot pell-mell into our ice-houses, and would be much better adapted for carriage and for general use. The thinnest films of ice could be turned to account, or snow could

be substituted for ice if desired. A regular ice-house would not be requisite; it would only be necessary to use a sufficient degree of compression, to stack the blocks as closely as possible in a cool place on an absorbent soil, and to cover over with straw surmounted by a sufficient thickness of sawdust. *Les Mondes, 11th March*, 1875.

Prevention of Souring in Beer.—JANIN, of Algiers, patents the following method of preventing the formation of lactic acid in beers:—To each hectolitre of beer add 5 grammes of bicarbonate of soda; then, in 500 gr. of spring water infuse 500 gr. of juniper-berries, with the addition of 10 gr. of wine-brandy. Add 10 gr. of the infusion to each hectolitre of the beer. *Bulletin de la Soc. Chim. de Paris, xxiii.* 6, 1875.

Isinglass for Fining Wine.—KULTUS states that at St. Petersburg, which may be regarded as the head-quarters of the isinglass trade, it is customary to bleach the dark and discoloured sheets of isinglass by chemical means. The bleached sheets are afterwards sold at higher prices, as of superior quality. But, as the clarifying powers of the isinglass are often impaired by the bleaching, no equivalent is received for the extra cost. Moreover, the bleaching materials are not always wholly removed, and may have an injurious effect on the wine. The same remark applies to the use of isinglass for pharmaceutical and culinary purposes, where the bleached sorts alone are employed. Large quantities of spurious isinglass are also now manufactured, which are difficult to distinguish from the bleached article. Long experience has shown the annotator that, so far as relates to the Astrachan isinglass, which is the best, the dark coloured is equally as good as the light. The surest tests are a fresh appearance, accompanied by a certain characteristic opalescence. *Indust.-Blätter, 11th March*, 1875, *from Neue Deutsche Indust.- und Landw.-Zeitung.*

Agricultural Products and Farinaceous Foods.—The imports of wheat into the United Kingdom vary according to the yield of our own harvest, but are gradually getting larger, having risen from 15,000,000 cwt. in 1857, to nearly 44,000,000 cwt. in 1873. The quantity of foreign flour received fluctuates greatly; in some years, as in 1862, exceeding 7,000,000 cwt.; in 1871 it was but 4,400,000 cwt., and in 1873, 6,200,000 cwt. The proportion per head of the population of imported wheat and wheat flour used was, in 1857, 66·29 lbs., and in 1873, 170·79 lbs. The agricultural returns of Great Britain for 1871 gave an average of 3,571,894 acres under wheat, and assuming an average yield of 4 quarters per acre, this would give a crop of 14,287,576 quarters, which, at 60*s.* per quarter, would make a total value of £42,862,728, for the British wheat crop. The wheat grown in Ireland is very small, only about 706,000 quarters being returned for 1871. South Australian wheat and flour are the finest in the world, and bring the very highest prices in London. Although the climate is capricious, and the average yield small and variable, the expense of cultivation is light, and the gathering of the crop by machines costs a mere trifle. In 1872, 200,000 tons of breadstuffs were shipped from Adelaide, which at the very moderate estimate of £10 per ton, gives £2,000,000 sterling as the result of the harvest, after supplying all local wants. Indian corn, or maize, finds but little favour in the United Kingdom as a human food-grain, although large imports are received for starch-making and the corn-flours, which are sold by several makers; but it is used most easily for cattle-food. The quantity of this grain produced in North America alone is sufficient to feed not only the population of the United States, but half that of Europe in addition, for a year. There are a couple of million farmers engaged there in the raising of maize. Some lands produce but 20 bushels to the acre, others 150, swelling the aggregate crop of the nation to vast proportions. The Indian corn crop amounts there to several hundred million dollars in value. The food preparations from maize sold in this country are "Kingsford's Oswego Prepared Corn," by Keen and Butterworth, "Duryea's Maizena," by the Glencove Company, "Glenfield Corn Flour," by Currie and Co., "Corn Flour," by Foulds, Gilmour and Co., of Paisley, Brown and Polson, Johnston, and others. Our imports of maize now range between 19,000,000 and 24,500,000 cwts. Large as the imports of rice are into this country (6,500,000 to 7,000,000 cwts.), it is a grain comparatively little used here for human food; its principal consumption being for starch making and food for stock. The food phosphates, although they do not exist in cleaned rice, are all present in considerable quantity in its husk. The Chinese are a rice-eating nation, and rarely use milk or cheese, but their remarkably intelligent ancestors have taught them how to keep up a constant supply of the phosphates, by boiling their rice in a clear solution of rice-husk ash-water, and the strength, flesh, bone, and muscle of the Chinese show what the food phosphates will effect. The millions of Bengal also eat rice, but the Bengalee boils his rice in plain water, and his physical inferiority proves that the use of food deficient in phosphates produces degeneration. An excellent corn flour made of rice is prepared and sold by Messrs. J. and J. Colman. Although maccaroni has long been known as the bread of Italy, in England, India, and elsewhere it is only regarded as an article of occasional use. It is very rich in flesh-forming elements, and the better it is known, the more highly will it be esteemed. In respectable Neapolitan houses, maccaroni is on the dinner-table at least twice or thrice a week; in many, every day. An effort has been made to manufacture maccaroni in England, in a more cleanly and effectual manner, by machinery, and Messrs. Criscuolo, Kay, and Co., employ a number of skilled Italian (Neapolitan) workmen at their establishment at Camden Town. The whole process of manufacture was shown in operation in the machinery court at one of the annual International Exhibitions. The best maccaroni is made from the hard, dark wheat (*Triticum durum*) of Apulia and Sicily, which, on account of its richness in gluten, is grown entirely for this special manufacture. It is a mistaken notion to suppose that the whitest maccaroni is the best, as the miller or baker, to give whiteness to his flour or bread, will frequently reject the most nutritious portion of his material, or use some artificial and more doubtful means to produce the same effect; so to please the eye of the English purchaser and obtain a better price, the unscrupulous Italian will whiten his paste at the expense of its most important element, gluten, which should be in the proportion of about 10½ per cent. A very correct and easy process for ascertaining the proportion of gluten in flour, is to place a weighed portion of flour in a small bag of very thin calico, and knead the contents under a pipe of water; soon the gluten will alone remain, when it can be readily detached from the bag, dried in the air, and weighed. It is strange that so little progress has been made in the manufacture of meat biscuits, which are so portable a form of food. When first presented to the public, by Gail Borden, of Texas, at the Exhibition of 1851, they were highly commended by the jurors, as a most simple, economical, and efficient form of portable concentrated food. And yet these meat biscuits have made but little way in public estimation. There are, however, two makers of meat biscuits, J. L. Johnston, of Edinburgh, and Peek, Frean, and Co., of London, biscuits made with Liebig's extract. *Simmonds' Journal of Applied Science.*

Purification of Water for Industrial Purposes.—BERENGER and STINGL'S method consists in precipitating first the bicarbonate of lime contained in the water, with milk of lime or with ordinary lime water. The carbonate and sulphates of magnesia, and magnesia chloride, oxide of iron, &c., of which very small quantities only are precipitated by the lime-water, are then precipitated with solutions of caustic soda, caustic potash, or other alkaline bases. These solutions are formed by adding the alkaline carbonates to a solution of quick-lime, taking care that hydrate of lime is present in excess, to ensure the precipitation of the carbonate of lime, silicic acid, and fatty and organic matters of all kinds. It is proposed to utilize the residue, such as the mother-water left by the crystallization of the soda after calcination. Lastly, the sulphate and chloride of lime, which are present in almost every water, are precipitated with alkaline carbonates. Suitable apparatus is provided for the treatment of the feed-water as above. In winter time, or in the case of very cold well-water, steam is injected with the water to raise it to a more suitable temperature. *Moniteur Indust. Belge, 20th March*, 1875.

New Icehouse at Brussels.—An icehouse of colossal dimensions has lately been erected outside the gates of Brussels, on the Charleroi Road, on the north side of the city. The roof covers an area of 1,600 square metres. The walls are double, the space between them being filled with moss and sawdust. There are nine separate ice chambers, each of 1,000 cubic metres capacity. Ample means of ingress and egress are provided, and lifts and tramways on each floor facilitate the distribution of the ice. In the upper part of the building are numerous galleries, approached by staircases from the outside as well as the inside of the building. In these a constant current of air is maintained by means of thirty-six ventilating shafts, so that the temperature never exceeds 2° R. (36½° Fahr.) These galleries are specially designed for the storage of fresh provisions during the hot weather. Room is thus afforded for hanging 2,000 quarters of meat, each quarter being perfectly isolated. A separate space is set apart for the storage of fish. Bottled beer and other liquors can also be housed if desired. A million tons of ice were stored in the building during the winter just past. A great part of the ice comes from water-meadows, which can be inundated at will; but large supplies of Norwegian ice are received as well. *Technologiste, March*, 1875.

Artificial Colouring of Wine.—M. L. ROUVIERE suggests the following method for the detection of a fraud, which has increased to a gigantic extent in France within the last two years—the artificial colouring of wine. The first stage of the proposed analysis proceeds on the supposition that the wine may have been coloured with *animal* or *mineral* substances. Three substances are used in the south of France, to an enormous extent, for colouring: ammoniacal extract of cochineal (or very frequently fuchsine), alcoholic fuchsine solution, and indigo sulphate, or sulphurized indigo blue. A small quantity of the wine is treated in a test-glass with caustic baryta and a little alumina, which gives a purple-red precipitate, where cochineal or fuchsine has been employed. This re-agent *never* fails. If the cochineal extract has been of inferior quality, the precipitate should be well stirred in three times its volume of distilled water, and left to settle. The water that rises to the surface will be a more or less deep red, if the wine has been artificially coloured, deep green or yellowish green, if it be pure. The second stage of the analysis is the testing for *vegetable* colouring matters. Various re-agents may be used. Caustic baryta with alumina gives a yellow precipitate in wines coloured with *phytolacca*, and a reddish yellow one, changing to brown, in those coloured with Brazil wood. Acetate of alumina is the best test for hollyhock flowers; acetate of copper, which gives a pure blue, and concentrated solution of acetate of soda, which gives a lilac, indicate colouring with elderberries, &c. A list of the most suitable tests for vegetable colouring matters is given in an excellent treatise by M. Brun of Geneva.

M. Rouvière, however, considers the most efficacious test for all purposes to be unravelled silk mordanted with chloride of tin or sulphate of alumina, and macerated in the suspected wine for a period of 24 to 48 hours. It fixes colouring matters of all sorts. It is the surest test for fuchsine, which, after washing and drying, may be separated from it by solution in methylated spirit. When hollyhock-flowers or poppies have been added to the wine, the silk remains a violet blue after washing; when the colour has been given with fruit-juice, it turns a deep or a yellowish green. A collection of samples of silk thus prepared by steeping in wines of known composition, and careful washing and drying, would form a convenient test scale. M. Rouvière commends the subject to the consideration of all interested in wine-analysis. *Les Mondes, 25th Feb.* 1875, *from Journal de la Pharmacie.*

§ 5. *Fuel, Heating, Illumination, &c.*

Fumigating Candles.—REISSIG, of Darmstadt, manufactures fumigating candles for disinfecting purposes, which emit a continuous stream of sulphurous gas, as long as they are kept alight. *Stummer's Ingenieur, 20th April,* 1875.

The Electric Light on Railways.—On the occasion of the Czar's late journey upon the Moscow-Kursk line, a method of lighting the line by electricity, suggested by the telegraph superintendent, is stated to have been tried with complete success. An electric light with a battery of 48 elements was carried on the locomotive. The light illumined the line for a distance of 454 metres ahead of the advancing train. *Moniteur Industrielle Belge, 1st April,* 1875.

§ 6. *Miscellaneous.*

Prevention of Explosions in Petroleum Lamps.—CHENEL patents (France) a method of preventing explosions, by the introduction into the lamp of a small quantity of powder composed of alum, common salt, resin, sal-ammoniac, camphor, ultramarine, and red and yellow ochres. *Revue Indust. 3rd March,* 1875.

Non-Inflammability of Textile Fabrics.—The ABBÉ MAURAU proposes to render textile fabrics of various kinds uninflammable, without affecting their colour, suppleness, strength, or wearing qualities, by treating them with a preparation of borax, sulphate of soda, and boracic acid, combined in suitable proportions. *Revue Indust. 3rd March,* 1875.

Hastening the Germination of Seeds.—BOETTGER states that a dilute solution of ammonia or a moderately strong solution of either potash or soda has a remarkable effect in hastening the germination of seeds. With coffee berries, which always germinate with difficulty, this is especially noticeable. A few hours after the berries have been moistened with a dilute solution of potash, the germs may be seen protruding to a length of 1 to 2 millim. *Bull. de la Soc. Chim. de Paris, xxiii.* 6, 1875, *from Polytech. Centralblatt.*

Cleaning Bronzes.—By dipping fustian in soluble glass, and washing it with soap directly afterwards, we get a fabric largely impregnated with silica, which will be found very well adapted for cleaning bronzes, &c. Samples of the material were in the Vienna Exhibition, and attracted some notice. *Revue Industrielle, March* 31, 1875.

Microscopic Examination of Paper-pulp. — M. AIMÉ GIRARD reports that he has determined, by microscopical observations aided by photography, the shapes, dimensions, and individual peculiarities of the various descriptions of fibre employed in paper-making. He has thus been enabled to define the characteristics of good papermaking fibre.

Great stress is generally laid upon the *length* of the fibre to be used for this purpose; but there appears to be really no reason for this precaution. Prepared pulp is found to consist chiefly of segments of fibres varying in length, according to the character of the pulp, from $\frac{1}{10}$ to $\frac{1}{10}$ mm., or from 1 mm. to 1·5 mm. This length is very rarely exceeded. Now, there is no sort of vegetable fibre which does not come up to or exceed this limit; consequently, so far as length is concerned, vegetable fibre of every description is suitable for making paper. But it is of great importance that the fibres should be slender—small in diameter in proportion to their length. In fibre which has been cut and rolled in prepared pulp this proportion should not be less than $\frac{1}{30}$. Moreover, the fibre should be elastic, and readily assume a spiral form, without which firmness and solidity cannot be obtained by felting.

The *strength* of the fibre, to which great attention is sometimes paid, is also of secondary importance. When a sheet of paper tears, the fibres rarely break; they become disentangled and draw asunder unbroken.

In accordance with these observations, and pending further researches, M. Girard divides paper-making fibres into five separate classes:

1. *Rounded fibres with strongly marked articulations.*—In this class are two materials only—hemp and flax.

The *textile* fibre of hemp differs altogether from its *paper-making* fibre. The former consists of fibres still united, forming fascicles of $\frac{1}{10}$ mm. in diameter. In hempen pulp these fibres appear as separate and independent filaments, in the form of rods marked with transversal articulations, having diameters of $\frac{1}{80}$ to $\frac{1}{30}$ mm. The filaments are fissile, separating readily into numerous smaller filaments, which take a firm hold upon each other, thereby giving great strength and firmness to the paper.

The filaments of flax much resemble those of hemp, but they are less fissile, and their diameters are smaller, not exceeding $\frac{1}{100}$ to $\frac{1}{50}$ mm.

2. *Rounded fibres, either smooth or with slight articulations.*—This class includes esparto, jute, *phormium*, dwarf palm, hop, and sugar-cane fibre.

In England about 250,000 tons of esparto are worked up every year. The fibre is slender and lanceolate, not exceeding $\frac{1}{100}$ mm. in diameter by 5 mm. in length. It felts very readily.

In England, too, about 200,000 tons of jute are employed annually. Various Indian plants with fibres all closely resembling those of hemp and flax, are included under this appellation.

The fibres of *phormium tenax* much resemble those of esparto. They felt very well.

The dwarf palm, treated by the chemical process, gives rounded, articulated fibres, of smaller size than those of hemp and flax.

Hop-fibre is beginning to attract considerable notice amongst paper makers. A decided advance has been made in the manufacture by the invention of machines for removing the outer cuticle of the plant. This removed, two descriptions of fibre are found—one small, not exceeding $\frac{1}{100}$ mm. in diameter, forming the bulk of the plant; the other large, $\frac{1}{30}$ mm. in diameter, which displays a degree of fissibility analogous to that of hempen and flaxen fibre.

Sugar cane is now converted into pulp in the West Indies by the chemical process. Thus treated, the "trash" furnishes round, even fibres, which felt well.

3. *Fibro-cellular substances.*—This class is represented by a single substance—pulp prepared by treating rye or wheat straw with a caustic ley of 4° or 5° Baumé, and afterwards exposing it to a temperature of 130° to 145° C. under pressure, for the space of six hours. The coexistence of the fibres and cellules in the alkalized product is distinctly marked.

M. Girouard attributes the defects of straw papers to the presence of these cellules, which are incapable of felting themselves, and interfere to some extent with the close union of the fibres.

4. *Flat fibres.*—This class comprises the fibre of cotton; wood pulp prepared by the chemical process, *i.e.*, by the action of caustic leys of 10° Baumé, followed by heating to 185° C.

under pressure; also the fibres of the agave, paper mulberry, and bamboo.

Cotton has flat-shaped fibres, which readily assume a spiral form.

The polygonal fibres of pine and fir wood form flat strips, in which alveolar tissue is present. The utilization of these fibres is now carried out on a very extensive scale.

Agave fibre is flat, and readily takes a spiral form. The mulberry gives a flat fibre of considerable length.

The application of the bamboo to paper-making purposes appears likely to acquire some importance. The bamboo produces a flat fibre, which takes the spiral form readily.

5. *Imperfectly defined substances.*— Mechanically prepared wood pulp completes the list of paper-making substances. It is not composed of fibrous matter properly so called, but of clusters of coherent fibres, sometimes with very few fibres in each, and at other times forming considerable agglomerations. In either, the mechanically prepared pulp does not consist of elastic fibres, but of rigid fragments, in some cases veritable sticks, which are incapable of felting properly, or giving other than very imperfect results. *Comptes rendus, lxxx.* 10, *8th and 15th March*, 1875. *Revue Indust. 24th March*, 1875.

Industrial Plants of Italy.—In a report on the late Vienna Exhibition, M. CARLO BERTI PICHAT gives some interesting particulars respecting various plants employed in Italy for industrial purposes. Passing over cotton, the olive, the walnut, and some others treated in separate reports, M. Pichat mentions that *Sesamum* has been successfully grown in the district of Bologna, producing 1,600 kilogs. per hectare (about 12¾ cwt. per acre) and yielding 47 per cent. of excellent oil. The culture of *Ricinus* (castor-oil plant), chiefly from imported seed, has much increased of late in certain parts of Verona. It gives an average of 512 kilogs. per hectare, the value of which is estimated at 1500 lire (about £25 per English acre).

Linseed is chiefly produced in the southern provinces. The produce of this article in Puglia and Calabria is valued at four and a-half million lire (£188,000) annually, and that of Sicily at one and a-half million lire more.

The management of *hemp* has undergone much improvement of late years in Italy; that of *flax*, although an older established branch of industry, has made less progress, and is carried on upon a smaller scale.

Genista (broom), by Mannoni's process, furnishes a good stout yarn, which bleaches well.[1] From 101 kilogs. of broom fibre about 18 kilogs. of yarn are obtained; this is exclusive of coarser portions, which can be worked up into cordage, &c.

The *Agave*, which attains an immense size as a wayside plant in Sicily, where it is popularly known under the name *Zabarra*, furnishes a textile fibre of considerable tenacity. Another filamentary substance, *byssus*, is not a vegetable product but the beard of certain deep-water molluscs found in the Bay of Tarentum and the Straits of Messina.

Italian *Madder* is stated to be very superior in quality to the French article, and might be advantageously grown on a large scale in the south.

The reporter directs attention to the superior advantages which Italy possesses over every other European country for growing *Tobacco*, and remarks that restrictions on its growth should be removed, and encouragement given to the culture both of that plant and of the opium poppy. *L'Economista (Florence), 14th March*, 1875.

Normal Composition of Glass.—M. BENRATH has lately instituted a series of experiments with a view to settle the moot question whether glass is a definite compound, as asserted by Dumas forty years ago, or simply an admixture of certain substances. To this end he has concentrated his attention on glasses of the best make—those manufactured at Birmingham and at the St. Gobain Works, at Aix-la-Chapelle. These glasses, which resist the action of wet and atmospheric influences generally better than any others, are distinguished by the presence of an exceptionally large proportion of lime, and otherwise present certain analogies which admit of their being referred to a common standard of composition. The results of his numerous experiments have led M. Benrath to believe that the normal composition of glass may be expressed by the formula—

$$5\left\{\frac{Na}{K}\right\}O, 3\,SiO_2 + 7\,CaO, 3\,SiO_2.$$

Moniteur Indust. Belge, 20th March, 1875.

A New Application of Paraffine.—The corks of jars holding corrosive acids, may, it is said, be rendered proof against the corrosive action both of liquids and gases, by dipping them in paraffine and afterwards drying at a temperature of 100° C.

The same method may be pursued with wooden vessels of all kinds used in manipulating powerful acids. *La Gaceta Industriel (Madrid), 25 March*, 1875.

Woollen Waste as Manure.—LADUREAU, of Turcoing, exposes woollen rags and waste to a temperature of 120° to 140° C. by which they are converted into a reddish tinder emitting a strong odour of chicory and burnt wool. Thus treated, these materials, which have been so long prized as manure on account of the large proportion of nitrogen they contain, are notably reduced in weight by the loss of 10 to 15 per cent. of water, and also rendered fitter for assimilation by the soil. With a guaranteed strength of 6 to 8 per cent. of nitrogen, the baked rags sell at 13 francs per 100 kilos.

M. Ladureau also manufactures a manure of the following composition, which sells at 20 francs per 100 kilogs. and is well spoken of:—

6 to 7	per cent.	of nitrogen (2 per cent. in the form of ammonia).
54	„	„ (organic substances).
5 to 6	„	water.
7 to 8	„	phosphate of lime.
1·5 to 2	„	potash.
5	„	magnesia.
2·5	„	soda.
22 to 25	„	sulph. of lime, oxide of iron, &c.

Industrie-Blätt., 11 *March*, 1875, *from Deutsche Industrie-Zeitung.*

Paper-pulp from Sugar-cane Refuse.—MM. MERITENS and KRESSER have obtained a patent for a process for the extraction of *cellulose* from refuse cane, which promises to prove of considerable value.

The refuse-cane or "trash" (*bagasse*), which heretofore has been used as fuel or manure, comes from the mill crushed and nearly white, but containing a good deal of saccharine matter intermixed with gum, albumen, and various foreign substances.

To eliminate the latter, the refuse is exposed to a jet of steam in a closed vessel, and afterwards re-pressed, either in the mill or in a special machine, where it parts with a considerable quantity of fairly concentrated saccharine juice, which can be treated by some of the methods in ordinary use in refineries and distilleries.

The solid portions are now nearly dry, and are converted into papermaking material by passing them lightly through an alkaline bath, and afterwards washing in acidulated water.

The material is handed over to the papermaker, either as simple fibre, drawn and cleaned, or as pulp, after bleaching with chlorine or other re-agents. The fibre so prepared is said to take less chlorine for bleaching than any other vegetable fibre.

As cleaned fibre the material can be shipped at 35 to 40 francs per 100 kilos. As pulp, the price is 50 to 60 francs per 100 kilos., with a reduction on larger quantities.

The advantages claimed for the process are:—an increased yield of sugar; increased value of the refuse; increased economy of fuel, as it is stated that 4,500 kilos. of refuse cane are required to do the work of 1,000 kilos. of steam coal.

M. Aug. Pinget, a French engineer, to whose notice of the process in the undermentioned journal we are indebted for these details, estimates that the general adoption of the process would add 50 million francs per annum to the gross revenue of the French sugar-growing colonies, taking the amount of sugar annually produced by the latter at 125 million kilos. Besides this, the impetus given to sugar-culture and the paper trade must be taken into account. *Technologiste, March*, 1875.

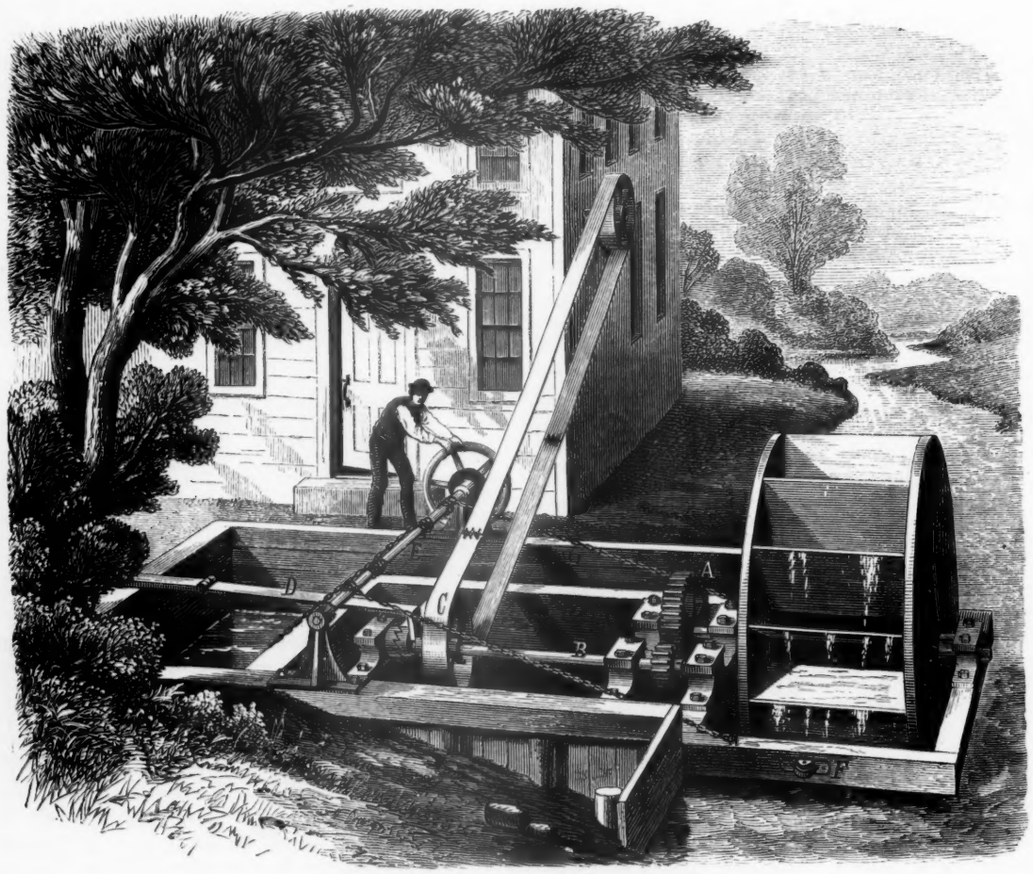
Extraction of Iron-filings from the Eye.—Iron filings have a way of embedding themselves in the eye, which defies almost every ordinary means of extraction. For their removal a small blunt-pointed bar of steel *well magnetized* will be found excellent, and we should recommend workmen liable to such injuries to keep such an instrument about them. It would be a good plan to insert it in a penknife handle, like a blade. *Scientific American, April* 10, 1875.

Elodæa Canadensis.—M. BRUINSMA contributes to the undermentioned journal some interesting notes on *Elodæa Canadensis* (Michaux), otherwise known as the Little Snake Weed or Canadian Water-pest. This plant was first observed in Europe at Warrington, in 1836, and has since made its appearance in other localities in the United Kingdom, spread over a great part of North Germany, Belgium, and Holland. It was

[1] A very interesting account of an improved process of treating the material will be found in the "Journal of Applied Science" for March.

first noticed in Holland in the neighbourhood of Utrecht in 1860, by Mequel; since then it has spread rapidly and given much trouble in the canals. M. Bruinsma endorses the opinion of Oudemanns, Rauwenhoff, Bolten, and other Dutch authorities, that turning off the water and mudding the infected bed thoroughly is the only method of extirpation. All others merely act as palliatives, by checking the growth. As the weed is used as manure, and as the value of aquatic plants for that purpose depends largely on the worms, snails, and water-insects of various kinds harboured by the foliage, whose perishing contributes to the decaying mass a large proportion of its nitrogenous matter, it may be well to note, that according to the observations of Dr. Menalda van Schouwenberg of Utrecht, molluscs and slugs are *not* found amongst *Elodæa*. The plant has been tried as fodder for cattle, at Nimeguen, with what result the writer has not learned. *Isis* (*Haarlem*), *Nos.* 4 *and* 5, 1875.

[The footnotes to M. Bruinsma's paper furnish a compendious and very useful list of the writings of Continental botanists and engineers, German and French as well as Dutch, who have treated of this redoubtable aquatic weed.—H. M. C.]



IMPROVED CURRENT WATER WHEEL.

THE invention illustrated in the above engraving is an undershot wheel, which is mounted in a float or raft. The latter is inclosed in a basin made by cutting away the bank at right angles to the stream, the sides being protected by piles and planking, or by stone revetments. The length of this slip is the same as that of the float, so that, if desired, the latter, with the wheel, can be carried back therein, and thus be removed out of the current. The raft is made of proper dimensions to balance the weight of the wheel, and the slip is excavated to a sufficient depth to float the apparatus at low water.

Our engraving shows the wheel projecting into the current and into operation. Its motion is communicated through gearing, A, to a horizontal shaft, B, supported in the middle portion of the raft. On this shaft slides a loose pulley, C, on the left-hand side of the hub of which is an annular recess and a clutch, to engage it when desired with the shaft B. In hub recess enters the end of a shipper lever, D, the other extremity of which is secured to the bank. A hinge in the middle of this lever allows of its adjusting itself to the position of the raft as the latter rises and falls with the varying level of the water.

It will be evident from the illustration that when the float is drawn into the slip for a certain distance, the lever, D, remaining rigid, will push the parts of the clutch asunder, so that such motion as the wheel may maintain will not be communicated to the loose pulley, nor through the latter, by the belt shown, to the point at which the power is to be utilized. On the other hand, however, when the raft is moved out so that the wheel enters the current, then the lever will draw the clutch into action and the power will be again transmitted; consequently the starting or stopping of the mechanism is readily governed by the means employed for moving the float, and this consists simply in a shaft, E, supported in suitable standards on each side of the slip, around which are wound chains leading to the opposite extremities of the raft. When the shaft is rotated, by the wheel shown in the hands of the figure to the left, the raft is necessarily drawn in; and when turned the other way, the opposite movement of the latter takes place. A pawl dropping into a recess in the shaft, E, holds the wheel in proper position when run out. Rollers, F, are attached to the longitudinal timbers of the raft to take against the planking of the basin, and thus to lessen the friction between the same and the raft, in moving the latter when the current forces it into close contact.

In streams which become swollen and choked with drift-wood during the heavy rains and spring freshets, the device above described will prove of especial value, since the possibility of withdrawing the wheel entirely out of the current affords an excellent means of protecting it from injury or destruction.—*Scientific American.*

Practical Literature.

LIFE OF THE REV. JEREMIAH HORROX.

DURING the past few months the name of the subject of this memoir has been brought somewhat prominently before the public, in connection with the transit of Venus which took place last year; and it is in order to gratify the very natural curiosity about a man whose name stands so deservedly high in the annals of scientific discovery, that this little volume is given again to the world. It is a simple reprint, with some emendata of a minor nature, of the Life as it originally stood, in a cheaper and more popular form; the translation of Horrox's treatise "Venus in Sole Visa," which appeared in the edition of 1859, being omitted.

The story of the short-lived but enthusiastic student of astronomy is told in plain and simple language, and is full of interest, as well from the scientific as from the personal point of view. The name and the labours of Jeremiah Horrox must be so well known to our readers as to need no retelling of the story here, and it only remains for us to say that we are glad to see a re-issue of the work, for which there is no doubt that a considerable demand has arisen.

SOME RECENT CONTRIBUTIONS TO THE PATENT QUESTION.[2]

EACH of these works is a useful addition to the literature of the "Patent Question," which is just now exercising the minds of every one who is interested in the manufactures of the country. The translator of the first book on the list gives as his reason for the publication, that the reports which appeared in the newspapers at the time of the Congress were very meagre, and did not do justice to the subject as settled at Vienna. It is not necessary that we should reprint the resolutions, but among them we find that the Congress pointed "to the English and American patent laws, as well as to the draft for Germany drawn up by the Society of German Engineers, as worthy of consideration." This record proves at least that the Continental patent laws are more defective than our own, and yet scarcely an Englishman is content with the law of his own country, and many point to the American law as superior; while the Americans are discontented, and claim the British, though defective, to be superior to their own; furthermore, the Society of German Engineers have recently amended their former draft, and if one may judge by what has been said in both Houses of Parliament, not one of the speakers, or even the Lord Chancellor himself, has shown sufficient ability to grasp the subject. How it will all end it is impossible to say, but it appears that either the Bill must be greatly modified or abandoned, or else it will end in another royal commission. Mr. Macfie's original opinion respecting the patent laws—their total abolition—is well known. He saw their injustice and their injurious effects on trade, and recommended a clear field and no favour. He has, however, latterly somewhat modified his views, and propounded suggestions which those who are interested in the subject will do well to consider. In 1869, when he presented a petition to the House of Commons from the Newcastle and Gateshead Chamber of Commerce for the abolition of patents, he was well supported by very able men in his arguments on the "abolition" side of the question. The pro-patentees, at the recent discussion on the subject at the Society of Arts, led by Mr. Bramwell, seem to have had the best of the argument; and Mr. Macfie, an abolitionist still, in his desire to have his side of the question calmly considered, has re-issued his book, first published in 1869—a book full of illustrations and anecdotes of the ill effects of the present law, and one that will well repay the perusal of any reader who takes the least interest in the patent question, whether he belongs to the abolitionist party or the pro-patentees. In addition to the foregoing, the relative subject of copyright is also treated very fully and fairly, which certainly was not its fate at the Society of Arts discussions. We may say, in conclusion, that the law cannot long continue as it stands, that it will not work as proposed to be altered by the Lord Chancellor, and its total abolition is neither just nor expedient.

LESSONS IN ELEMENTARY MECHANICS.[1]

ALTHOUGH this book is put forward, as the title-page states it, "for the use of candidates for the London matriculation, preliminary scientific, first M.B., and other examinations," the peculiarly objectionable features of a "cram" book are apparent in but a very small degree. The treatment of the subject is thorough so far as it goes—it is an "introductory" and an elementary book,—and the method of its arrangement has some elements of novelty. In accordance with the view held by the author, that the idea of motion is more elementary than that of force, and that two forces, at least, must combine to produce equilibrium, the subject of statics has been made to depend on the laws of dynamics. After very carefully reading the opening chapter of the work, in which the first principles are laid down, we are bound to record our opinion that the beginner approaching the subject by means of this book, is much more likely to gain an accurate idea of the laws of force by Mr. Magnus's method than by those usually adopted. The former appears certainly to be the more logical, and Mr. Magnus asserts that his practical experience in teaching has convinced him of the superior advantages which it offers to the student.

The propositions are illustrated by examples which have been worked out with care and lucidity, and valuable aid is rendered to the student who purposes to present himself at the London University Examinations by the classification of the questions set in the Examination papers of the past few years, which are appended to the various sections of the book. Without practically testing it by teaching experience, it is difficult to estimate precisely the value of the book for the purpose for which it is intended. We feel no doubt, however, that it will be found, while sufficiently elementary to be placed in the hands of a beginner, a trustworthy basis for the subsequent work of the student.

ELEMENTS OF PRACTICAL CONSTRUCTION AND PRACTICAL HYDRAULICS.[2]

THESE two volumes, compiled for students in general engineering, are constructed on the same general plan, and it may be sufficient with respect to that on practical hydraulics to record the fact that it has been so favourably received by those for whose use it was intended that it has now reached a third edition. To the civil engineer the examples and

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[1] *Memoir of the Life and Labours of the Rev. Jeremiah Horrox, Author of "The Transit of Venus over the Sun, Nov. 24, 1639."* By the Rev. Arundell Blount Whatton, B.A., LL.B. London: W. Hunt and Co. 1875.

[2] *The International Patent Congress in Vienna, 1873. Translation of Dr. Hermann Grothe's Report.* By A. Hildebrandt, C.E. London: Simpkin, Marshall, and Co.

The Patent Question in 1875. The Lord Chancellor's Bill and the Exigencies of Foreign Competition. Submitted for the earnest and early Consideration of Chambers of Commerce and Agricultural and Industrial Associations. With a Suggestion as to Copyright. By R. A. Macfie. Second Thousand. London: Longmans and Co.

Recent Discussions on the Abolition of Patents for Inventions in the United Kingdom, France, Germany, and the Netherlands. Evidence, Speeches, and Papers in its Favour. With Suggestions as to International Arrangements regarding Inventions and Copyright. London: Longmans and Co.

[1] *Lessons in Elementary Mechanics Introductory to the Study of Physical Science.* By Philip Magnus, B.Sc., B.A. London: Longmans. 1875.

[2] *Elements of Practical Construction for the use of Students in Engineering and Architecture.* Part I. By Samuel Downing, LL.D. London, Longmans, Green, and Co. 1875.

Elements of Practical Hydraulics for the use of Students in Engineering and Architecture. Part I. By Samuel Downing, LL.D. Third Edition, revised and enlarged. (Same publishers.)

practical applications will possess very considerable value, aided as they are by numerous woodcuts in the text.

The first-named of the two volumes treats only of the resistance of materials to direct compression and tension, the author having left to a future volume the subjects of elasticity, indirect compression and tension, transverse resistance, torsion, &c.

Each material is treated of by itself, and a proposition is given stating its average ultimate resistance; a series of experimental proofs with reference thereto are next given; and then follow illustrations of the material so strained taken from completed and successful structures of eminent engineers. We may remark that an atlas of plates is referred to in the title-page, which has not reached us, and which has therefore necessarily rendered our examination of the book an incomplete one.

The author informs us that the experiments and some of the examples have been taken from the proceedings and transactions of learned societies, and we think he has rendered a real service to beginners in their profession by collecting these, which are to a large extent inaccessible to the majority.

It is only due to them to repeat what the author states in his preface, that the provost and senior fellows of Trinity College, Dublin, where the author holds the post of Professor of Civil Engineering, have taken upon themselves a part of the cost of producing the work.

THE HANDY BOOK OF BEES.[1]

THIS is one of the most delightfully written and charming treatises on a subject full of the most instructive interest that it has been our fortune to encounter for many years. By this time no doubt the book has become known to every intelligent apiarian in the country—if it has not done so, we can only say it is high time that it did. The reception given to the first edition was such as to stamp it at once as a standard work on the subject, and we are glad to see that the author has taken advantage of the opportunity afforded by the issue of a new edition to add some important practical details which were not given in the first.

For the benefit of those who have not yet made themselves acquainted with the work we may mention that it is divided into two parts, which treat respectively of the natural history and of the practical management of bees. So curious and little known are the ways of these wonderful creatures that the details contained in the first part of the work, coming as it does from an enthusiastic lover of them, will prove to a vast number of people as interesting as a first perusal of Captain Gulliver's marvellous adventures in the land of Lilliput, while they possess the additional charm of being perfectly true, and based upon constant, careful and loving observation. The part which treats of the practical management is written with the clearness and skill which only a man with a thorough acquaintance with his subject could employ, and the wonderful results which the author has achieved in bee-keeping and honey-harvesting are a sufficient guarantee of their practical value.

The calendar of operations is an addition of great importance, and was the one thing needed to make what is a most valuable and interesting treatise complete.

NAVIGATION IN THEORY AND PRACTICE.[2]

DR. EVERS' name is a well-known one in connection with this and kindred subjects, and is a sufficient guarantee that any work from him will be such as to command the attention of all who are interested in them.

This little volume, written with admirable clearness and perspicuity, is intended to give the student an insight into the Theory and Practice of Navigation; and this is done in as easy, practical, and thorough a manner as it is possible to do it,—the definitions, illustrations, &c. being presented in every variety of aspect, and with constant application to actual operations.

The opening chapters, after giving some very concise and intelligible definitions and preliminary illustrations, treat of the compass and its declinations, the log, log-line, and log-glass, and the method of recording the day's work. Next follows the consideration of plain, traverse, current, parallel, middle latitude, Mercator's and great circle sailing, each of which is treated in a chapter by itself. These lead up to the final chapters, which are an exposition of the principles of the more difficult operations of sailing or plying to windward, and oblique and current sailings; and a set of questions is appended to each section of the work, which has in addition a copious index.

It will thus be seen that our commendation of the work for its completeness is merited; and we feel certain that no better tutor can be wished for by the earnest student than Dr. Evers' little volume.

HUMAN ANATOMY.[1]

THE author of this work tells us that it was prepared for the article Anatomy in the ninth edition of the "Encyclopædia Britannica," and we think that he has done well to accept the advice of his publishers, to reproduce it in a separate volume. The work claims to be an exposition of the principles on which the human body is constructed; and while the book is therefore much more than a simple enumeration and description of the various organs, it is so minute in its detail as to be found useful by those who desire to master both the principles and the minutiæ which make up the whole.

It is characterized by a singularly close adherence to the subject, which is treated in a purely technical manner. None of the inferences, deductions, and speculations, which are now so fashionable in our scientific treatises, are indulged in; and while on this account it will not perhaps be found so attractive, even to those interested in the subject, yet it cannot fail to be of considerable practical value to the student, or in fact to any one desiring to gain a knowledge of this most important branch of science. We cannot help saying, however, that this value would have been largely enhanced had the book been provided with an index.

THE PRACTICAL MILLWRIGHT'S AND ENGINEER'S READY-RECKONER.[2]

THERE is but little to say of this well-known and valuable volume, except the chronicling of the fact, that it has now reached a fourth edition. It is as complete as could be wished; and so far as we have tested it, we have found its calculations to be accurate. It is easy of reference, and its utility is incontestable.

HYDRAULIC TABLES.[3]

THIS is a new and considerably altered edition of another of the Messrs. Lockwoods' valuable and important scientific and technical treatises, reproduced in a more convenient form for the engineer and the student than that in which it was formerly issued. The additions referred to, consist of new formulæ for the discharge from tidal and flood services and syphons; general information on rainfall, catchment basins, drainage, sewerage, water supply for towns and mill power.

The comprehensive title-page of the work will indicate its scope quite as clearly as anything that we could say would do; and we trust that the enterprise of the publishers, in bringing out a new edition of a work which is so expensive to produce as this one, and which can after all appeal to but a very limited public, will be fully rewarded.

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[1] *The Handy Book of Bees. Being a Practical Treatise on their Profitable Management.* By A. Pettigrew. Second Edition, revised and improved. Edinburgh and London: William Blackwood and Sons.

[2] *Navigation in Theory and Practice.* By Henry Evers, LL.D. London and Glasgow: Wm. Collins, Sons, and Co. 1875.

[1] *An Introduction to Human Anatomy, including the Anatomy of the Tissues.* By William Turner, M.D., Professor of Anatomy in the University of Edinburgh. Edinburgh: A. and C. Black, 1875.

[2] *The Practical Millwright's and Engineer's Ready Reckoner; or, Tables for Finding the Diameter and Power of Cog-wheels; Diameter, Weight, and Power of Shafts, Diameter and Strength of Bolts, &c. &c.* By Thomas Dixon. Fourth Edition. London: E. and F. N. Spon. 1875.

[3] *Hydraulic Tables, Co-efficients, and Formulæ for Finding the Discharge of Water from Orifices, Notches, Weirs, Pipes, and Rivers.* By John Neville, C.E., M.R.I.A. Third Edition. London: Lockwood and Co. 1875.